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A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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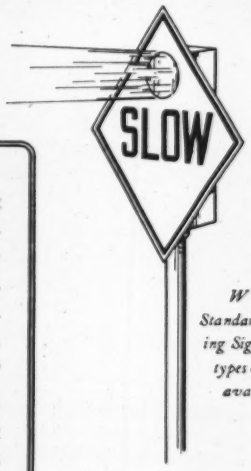

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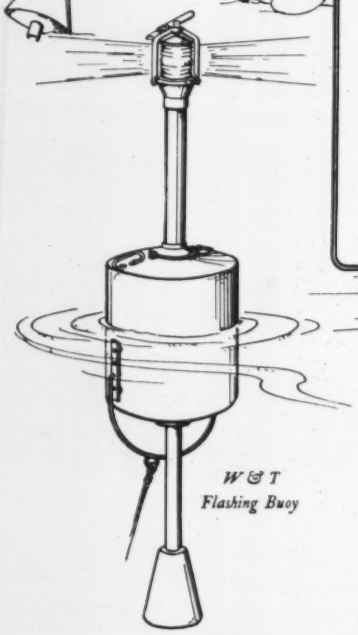

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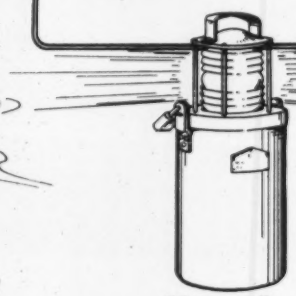

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

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Back to Work

THE NATION has been on a spree of speculation. Any doubt of the fact which previously may have existed was dispelled by the tremendous and hysterical unloading of stocks during the past two weeks. Watching stock quotations had become as popular an occupation as watching the thermometer used to be. And stock quotations had replaced the weather as a universal topic of conversation. In consequence, business suffered. Not vitally, perhaps, but certainly individual efficiency must have been impaired. Hurry, concern and nervousness are deterrents to sound and logical thinking. Stock trading is a necessary and legitimate business, but after all it is just trading. It builds no roads, designs no buildings, dams or bridges, nor adds one atom to the national wealth. There is just a shade of possibility that some of the mathematical acrobatics expended in figuring possible paper profits on stocks might have been better employed if played upon a slide rule. The present decline is a timely warning. Next time a healthy volume of sound business and of credit may not be available to act as a shock absorber. Certainly it will not be unless everybody gets back to work and forgets the stock tickers for a while.

The Effect on Construction

THROUGHOUT the year total construction has been less than in 1928. Residential building, largely speculative, has been distinctly depressed. Engineering construction, on the other hand, has remained consistently above last year's levels. This was the situation to Oct. 1. Then came the collapse of the stock boom. Authorities seem agreed that (1) the crash had to come, (2) it will set back business temporarily, (3) it will help construction. It had to come because all bubbles eventually burst. For a time it will hurt business, particularly retail trade, because millions of persons have lost money and general trade must suffer for their speculative excesses. On the other hand, it will help construction by easing building credit. Since early in 1928 credit costs have been rising quite steadily until mortgage money has become very difficult to obtain. Even guaranteed mortgages, bearing 5½ per cent interest, once largely bought by insurance companies and savings banks, no longer find a ready market and the title companies have been compelled to discontinue such loans. The second-mortgage situation is still worse, to the discouragement of builders and subdivision developers. Loans for financing large projects are becoming prohibitive due to high interest rates and the difficulties of disposing of mortgage paper. The high cost of financing has been evident also in the public works field. The immediate effect of the stock depression may be the postponement of certain projects, particularly in the public utilities field. This should be more than made up, however, by the release of funds for construction in general. This year's gain in engineering construction has been confined to private work. Public construction has been remarkably even in the last four years, and, on the basis of ten months' figures, this year's total will exactly equal last year's. Even with a better credit situation, residential building may continue to decline for several months because of adequate supply; other private construction may decline due to diminished production; public works construction should be normal for the season. Construction may be deferred, but it can never be abandoned while commerce and industry go on, and all authorities agree that these are sound. As a result of the stock-market debacle there is therefore rather less need now for deferring construction work than there was before it occurred.

Exchanging Byproducts

A NOTABLE example of the way in which byproducts may be converted into valuable assets is found in the new steam and electric power plant to be built by the Louisiana Steam Products, Inc., a subsidiary of the Engineers Public Service Company, at Baton Rouge. The prime purpose of the new plant will be to supply steam to the adjoining oil refinery of the Standard Oil Company of Louisiana. In this operation it will use as part of its fuel supply the waste oil and sludge from the refinery. The steam which it produces will not, however, be generated at the low pressure required by the refinery, but will be generated at a much higher pressure and fed through steam turbines to generate electric power for general utility purposes before being delivered as low-pressure steam to the refinery, a mere byproduct of power production. Thus the two industries by interrelating their operations will each put a byproduct of the other to useful purpose.

Warning From Fond du Lac

AFTER the event it seems clear that easily undertaken precautions would have detected the water pollution that caused the Fond du Lac typhoid outbreak noted in our news section last week. Possibly foresight would have prevented the outbreak, but apparently it would have been of a rather uncommon type. More complete information is needed before final judgment can be ventured. It seems clear, however, that this and many if not most other water supplies are not so safe against possible pollution as to warrant letting them go without periodic analysis, the interval to depend upon a careful weighing of all local conditions, aided by expert knowledge and judgment. Ready means should be at hand for quick action in case pollution is indicated. This need not always mean chlorination apparatus and a supply of chlorine at hand, in these days when on short notice both can be rushed to a point of need, but it does mean alertness to recognize danger and act accordingly on the part of local water and health officials. It is only fair to state that such a channel of infection as is reported from Fond

du Lac—through an abandoned private well, opened up in flood-control work, to the water-bearing strata from which the city supply is obtained—may not present itself often and therefore may not be recognized and guarded against. However that may be, it is now evident, if it were not before the Fond du Lac outbreak, that relatively shallow "deep wells" near a polluted river may be seriously polluted by some one of the many operations that may be undertaken in these days. The cost of frequent water analysis and of readiness for chlorination, and for that matter year-round chlorination, fade into insignificance after a typhoid outbreak.

Faulty Street Operation

BECAUSE of heavy traffic a narrow city street recently was widened by setting back the curbs to provide an additional traffic lane. Shortly after completion of the work double parking came to be practiced in this street, and soon there was even less space for fluid traffic than before. The value of the widening was thus neutralized by faulty operation. As is the case in most cities, the city where this happened depends on its police department for prescribing as well as enforcing traffic regulation, and that department is to blame for the virtual failure of the improvement. The result is not unnatural, however. The police first and always are occupied with prevention and detection of crime, and can deal with traffic only in an incidental way. Efficient utilization of traffic facilities can be expected only when regulation is assigned to a separate and properly qualified bureau of the city government. To devote public taxes to building physical improvement designed to facilitate traffic seems idle and wasteful unless the improvements are properly operated. Placing traffic regulation in competent hands therefore comes before the building of physical improvements in a program of traffic relief.

Sentiment or Service

TWO buildings of extreme height are under construction just now in New York City, which, according to credible reports, have been engaged in a race for greatest height. Repeated alterations were made in the plans, even after construction was well advanced, to add a few feet of height so that the other building might be surpassed. The contest is a curious happening. It places sentiment before service; advertising renown before utility value. The elementary conception of a building as the response to a definite need for housing, coupled with maximum esthetic satisfaction, plays no part in a competition for mere height. Whether the controlling consideration in the present contest was the owners' sentiment of pride or a sought-for special advertising appeal that would increase the rentability of the buildings is uncertain; but, with other large buildings being projected, there is no reason for thinking that the barely attained height supremacy of one or the other of these two buildings will long endure. The owners' feeling of pride may therefore be short lived. As for greatest rentability, common sense suggests that best planning of space and convenience facilities can do more to assure continued earning power of such a structure than the addition of a few feet of turret, which in the last analysis can do little more than burden the usable office space below with the cost of carrying an unnecessary addition of topsail area.

Reclamation or Free Storage

UNDER the leadership of James R. Garfield a Presidential board is to make a detailed study of the remarkable proposal for new policies as to public land administration and reclamation construction which President Hoover and Secretary of the Interior Wilbur have sponsored. The subject is difficult and contentious, but Mr. Garfield's judicial temper of mind and the experience he gained through serving as Secretary of the Interior give promise that the inquiry will be well guided.

Two distinct matters are covered by the Hoover proposal: one, that the unreserved Western public lands—which are mainly desert lands with some grazing value—be transferred to the possession and management of the several states; the other, that federal reclamation be discontinued and that in its stead the government undertake to provide free storage of the floodwaters of streams. The former, which has aroused much hostile discussion in the two or three months since it was broached, is not of specific interest except as it may prove to be the first step in a process which will ultimately give the states control also of mineral and forest lands. The proposed change in the system of federal reclamation is of direct importance to engineers, however.

It means abandonment of the policy established by the famous act of 1902, which led to the construction of great hydraulic works in all parts of the West. President Hoover rightly points out that the act was abused and misapplied almost from the beginning; it was framed to reclaim public lands for homesteaders, but was applied almost wholly to the reclamation of privately owned lands, to the speculative benefit of the landowners. If the reclamation act is abandoned, irrigation in future would have to be undertaken either by state authorities or by private enterprise. Moreover, it would inevitably be placed on that basis of economic justification which has been lacking in the federal system: a project would be undertaken only on decidedly attractive prospect of returning its cost with interest and development expense included.

Such a transformation of a long-established system is obviously of far-reaching effect. Private and district irrigation has languished in recent years, and irrigation securities do not find a ready market. State action in undertaking irrigation development has been limited to a few special cases. Attempts to give indirect state assistance, as by backing the bonds of districts by short-time guarantees, approving irrigation bonds for savings-bank and trust-fund investment, and partly financing districts by buying their bonds, have proved mischievous.

Will the transfer find the states ready to assume the responsibility? There is reason to doubt it. The states have not been willing to share in the work heretofore, though many opportunities presented themselves. Moreover, the chance of harmful political influence is even greater in state administration than in the federal—and in the latter its damaging effects on reclamation have been serious enough. Private and district irrigation holds out greater promise. With removal of the competition of interest-free irrigation financed by the ample Treasury at Washington, this field of development can grow on a healthy basis of benefits greater than costs, and if safeguarded by constructive state legislation, can attain a financially sound and economically fruitful position.

Most revolutionary of all the elements of the proposal is the plan to provide free floodwater storage at federal cost. It is a new form of subsidy to irrigation, and if

we accept the view of those who hold that no development of arid land is possible without a subsidy, this plan has at least the merit of fixing definitely the amount of national contribution. But at the same time it means that the government assumes a vast, virtually limitless obligation to control streams and store their waters, and in the contest for priority there would be an incentive for log rolling on a scale never before witnessed.

The vital question arises, Will the obligation to control and impound streams extend also to the eastern two-thirds of the country? Are all flood-control works to be provided by Washington? Fairness obviously demands that the principle of free federal storage be applied on a countrywide basis, not with sole eye to the claims of the West. But whether such extreme entrance of federal control and activity into local affairs is desirable merits the earnest consideration of those who believe that government should do no more than govern.

Difficulties and problems of many kinds thus enter into the work of the new board. All phases of the subject are worthy of study. The results of the inquiry are not likely to be free of controversial elements, but they will contribute to a better understanding of many complex issues involved in national development.

The Proper Approach

MOST municipal airports in the United States are still being built in a haphazard manner. Too many communities have approached the problem of airports only as a real estate development and as a new field in which to make political capital. As a result, after three years of intense activity in airport construction, few cities have anything to show for their money except fancy hangars, a muddy field and, if the politicians painted a bright enough picture of the future, an administration building. What is worse, this short-sighted plan has given engineers little opportunity to study the service characteristics of runways and to experiment with drainage layouts and other necessary factors. The field surface, the most important part of any airport and the fundamental reason for its existence, has been neglected. It is refreshing, therefore, to read in W. W. Horner's article in this issue of what St. Louis is doing. No better airport creed could be adopted by any city than the one St. Louis is following: "To proceed with no construction on a large scale until satisfied with the basic factors behind a proper design. On the other hand, to carry out immediately, on the smallest scale consistent with satisfactory operation at the field during the next year, construction of such types of improvements as will be needed for observation and research essential to arriving at the proper final policy." This statement is a frank recognition of our lack of knowledge, both with regard to the future course aeronautics will follow and with regard to the engineering structures that will serve present aeronautic requirements efficiently and economically. Many valuable data will be gleaned from the experimental work on runway surfaces. Already it has been determined that airport drainage is storm-water drainage and not agricultural or golf course drainage. St. Louis has adopted the proper approach. As soon as the majority of airports are developed along similar lines, so soon may we look for real advancement in airport construction. With a few notable exceptions, the past three years has contributed comparatively little to knowledge in this new field of engineering activity.

Low-Cost Road Problems

IT IS generally known that research is necessary in the development of the higher type roads that are called upon to carry heavy loads and at the same time to be sufficiently permanent to endure until the maturity of the bonds with which they are built. Scientific knowledge of the physical features of low-cost roads is as limited as is knowledge of a sound policy of financing and apportionment of funds between primary and secondary roads. The fact is worthy of note, therefore, that the whole session of the fall meeting of the Asphalt Paving Conference was devoted to this subject and brought together descriptions of a surprisingly large number of methods used in various parts of the country ranging from the mixed-in-place soil and gravel road to the plain oiled road of Illinois and the multiple-lift bituminous macadam of Oregon. Likewise costs were noted which ranged from a few cents per square yard to a dollar or even more. Traffic to be served varied from 200 to 2,500 vehicles per day.

On the physical side of the development of secondary roads close relations are being maintained between the Asphalt Association and the U. S. Bureau of Public Roads in a countrywide investigation of various types both as to construction history and as to subsequent performance. Much should come of this work especially if the difficult task of interpreting the results is attempted.

So much for the physical side. The financial side is of far more import just at this time, since the American Farm Bureau Federation proposes to make a concerted drive for an increasingly large portion of future federal and state aid funds to be spent on secondary roads rather than on the trunk line primary systems.

Road improvements, whether on primary or secondary systems, confer benefits on the general community, on abutting property and on the road user. Funds are raised from all three sources and to be strictly just should be expended in direct relation to the relative benefits accruing. If we knew what portion each should contribute and in what ratio the funds should be allocated among the through routes, the community roads and the purely local roads, we could set up equitable programs without so much political interference as now occurs. Here again, then, research is essential if we are to get even a tentatively correct program. We need to know economic changes in typical communities due to road development and at what stage benefits to the road user begin to overshadow the general benefits. We need to know land-value increases due to road improvements so as to set an equitable property tax. Properly to lay a user tax, such as a gasoline tax or registration fees, we need to know vehicle operating costs on various types of roads and all the factors obtainable only by very comprehensive traffic surveys.

Two distinct types of research, therefore, are essential in any study of highway problems: research into the physical characteristics of roadbuilding materials and surfaces, and research into the economical changes which improved roads bring about. Major road systems, of course, will benefit much by such studies, but the fullest general benefit will not come until research into secondary road problems and characteristics goes hand in hand with that directed toward major road systems.

Drainage and Runway Studies at the St. Louis Municipal Airport

All Major Construction Undertaken on an Experimental Basis—Field Drainage Planned for Stormwater Needs—Runways of Concrete, Sheet Asphalt, Asphalt Macadam, Mixed-in-Place Bitumen and Others With Tar and Road Oil Binders Being Studied in Use

By W. W. Horner

Chief Engineer, Sewers and Paving, City of St. Louis, Mo.

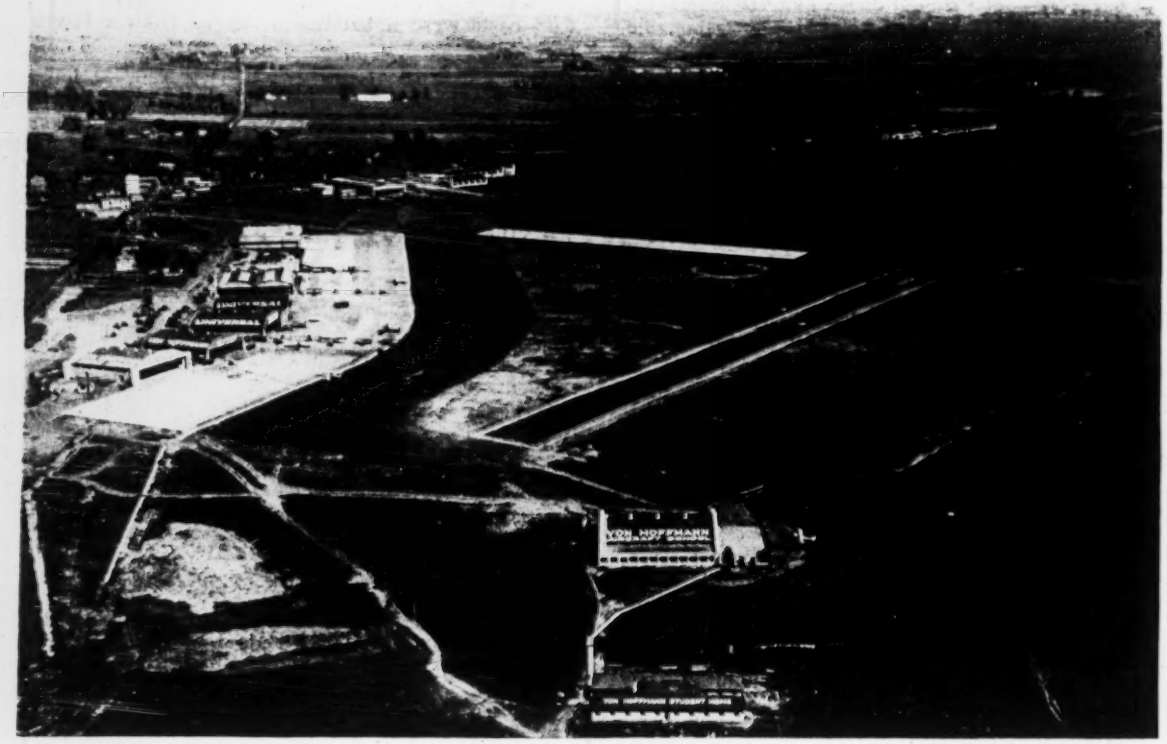


FIG. 1—ST. LOUIS MUNICIPAL AIRPORT WITH CONCRETE APRON AND FIRST EXPERIMENTAL RUNWAY COMPLETE. View shows western storm drain bordering apron and also rockfill trenches along runway. Work on the asphalt runway is in progress to right of circle marker. The third runway was built just beyond and parallel to the Von Hoffmann Aircraft School. Note also the oiled strip 200 ft. wide adjacent to the apron.

THE airport in St. Louis is under the custody of a municipal airport commission headed by the director of public welfare, and the engineering service of the city was not connected with it until after land had been acquired. At that time there was in operation a section of the field which had been the old Lambert-St. Louis field, but a creek of considerable size separated this area from the remaining lands. Although building development had been carried out to a considerable extent, no drainage or sewerage had been placed except one small line for hangars, and no general plan of development had been seriously considered.

In the face of insistent demands upon the commission that construction work be started on a large scale, it devolved upon the writer to analyze the necessities and the economics of the situation, to make recommendations to the director of public welfare and later to carry out a proper program of field improvement. Inquiry showed that we were facing a problem that was worrying city engineers throughout the country—namely, the demand for the immediate construction of airport improvements in the face of a distinct lack of any approved methods of practice, any developed technique or even any reasonable consensus of opinion as to basic factors from which to develop a design. The recommended policy which is now being carried out in St. Louis can be briefly stated as follows:

To proceed with no construction on a large scale until satisfied with the basic factors behind a proper design. On the other hand, to carry out immediately, on the smallest scale consistent with satisfactory operation of the field during the next year, construction of such types of improvements as would be needed for observation and research essential to arriving at the proper final policy.

The improvements coming within the scope of this policy have consisted almost solely of matters relating to

field conditioning, the proper handling of rainfall and sub-surface waters and the artificial surfacing of those areas needed for service aprons or runways.

Concrete Apron—The first and most urgently needed improvement was the construction of the concrete service apron in front of the hangars and passenger terminals. It was decided to make this apron the full length of the buildings, 1,500 ft., and to give it a width of 200 ft. It was so designed that rails or fences can be set in sockets 60 ft. from the buildings, leaving 140 ft. for servicing planes in an area completely separated from the crowd. Inasmuch as this apron will be used by service trucks of all kinds, it is built for practically state highway loadings, and is constructed as ten 20-ft. wide parallel stretches of standard concrete road. The strips are separated by asphalt expansion joints at intervals, and the standard center joint construction actually divided the pavement into 10-ft. widths. The strips were given a thickness of 8 in. at the edge and 6 in. in the center. Standard bar reinforcement was used, and the surface was tamped with a vibrator. This work, equivalent to 3 miles of normal rural highway, was done for about $2.10 per square yard. As far as we know, it is the most extensive concrete pavement in any airport.

Main Drainage—Though the field comprises nearly 600 acres, the old and the new parts were entirely

FIG. 2—WESTERN STORM DRAIN UNDER CONSTRUCTION
Shows manner of introducing stormwater into segment block and large pipe sewers. View taken at manhole.

separated by Cold Water Creek. At the time of purchase it apparently had been the conception of the aeronautical enthusiasts that this creek could be cheaply inclosed within some small form of boxing and thereafter forgotten. A study of its characteristics showed a drainage area of more than 6,000 acres, the greater part of which was in process of turning from agricultural into suburban occupancy, and stormwater flooding of the field was already beginning to indicate possible flood flows of the future. A proper sewer or culvert to carry the future runoff for this valley might have involved a 25-ft. section, but because of the shallowness of the creek, construction would have had to take the form of a number of 8-ft. sewers; inclosure in this manner, were it to extend even one-half the distance across the field, would have required the whole sum budgeted for construction.

It also developed that a drainage district had been organized for this valley, had acquired easements and had actually awarded contracts for the construction of an improved ditch along the general line of the creek, this ditch naturally designed on a farm drainage basis only. Its permanent presence would have entirely prevented the use of the land as an airport.

The simplest solution of these difficulties was found to lie in detouring the creek to the extreme edge of the undeveloped area, and plans for this were worked out, although it involved removing a 20-ft. knoll at one point before starting the ditch work. The detour ditch as contracted for was given a capacity about 50 per cent greater than that of the farm drainage district. It

FIG. 3—WESTERN STORM DRAIN COMPLETE
Subgrading for concrete apron at right and administration at extreme right. Drain later filled flush with apron.

consists of about 9,000 ft. of 15-ft. bottom section with depths varying from 10 to 25 ft.

Although the city was prepared to construct this detour channel at its sole expense and donate it to the drainage district, technical legal points were raised as to the right of the district to alter its plan even when a considerable saving of cost was assured. As a final compromise, the drainage district agreed to delay action on the construction of its original ditch across the field until this point could be settled in the higher courts. It is proceeding to complete its channel both upstream and downstream and the city will shortly complete construction of the section within the field itself.

Grading—That part of the area to the west of the creek which had heretofore been used as a landing field was nicely graded at a slope of about 1½ per cent from the western edge to the general line of the bisecting creek. The grading of the eastern or newly purchased part of the field was made a part of the same contract that covered the digging of the detour ditch. The grading work involved cutting away the high knoll already referred to, filling in swampy areas to the east of the creek and general shaping of about 175 acres. The field grading involves the handling of about 225,000 cu.yd. and the diversion ditch and branch drainage ditch of about 165,000 cu.yd. of earth. When completed, the new or eastern half of the field will offer a counterpart of the old half, so that for the field as a whole both sides will slope gently to a central valley along the general line of the abandoned creek.

When the problem of designing a system of satisfactory drainage for the field came into the office a

general research of literature and a resurvey of practice in this matter was made, but these brought to light nothing which seemed to us to represent a definite or even satisfactory approach to the subject. So far as the literature indicated, drainage elsewhere had been worked out along the lines of farm tillage practice modified very much as it occasionally has been for golf courses. Considerable study had apparently been given to soil conditions, but very little to the economic intensities of rainfall for which a runoff was to be provided; nor did there seem to be many data available as to the actual runoff percentages from such rainfalls. Neither was there any well-determined idea as to the kind of surface which ultimately would exist on the field and which would be one of the greatest features in fixing the rate of runoff.

A general discussion of this whole subject with all the experts of the locality, including those connected with some of the greater aeronautical interests, failed to clarify the situation to any great extent. In the end it was practically admitted that the possibility of maintaining a satisfactory turf, in the Middle Western climate at least, was definitely debatable; that the amount or proportion of surface which would be covered with runways was a matter still to develop out of the experience of the next few years; that airport operations have not yet reached a point where the presence of standing water on the field during and immediately following rains can be said to be detrimental to operation to any definite extent, or where removal of the water could be given a specific money value.

This summary of conditions seemed to indicate that one person's guess as to desirable conditions on the airport of the future is as good as another's; that we would be wise to guess on the conservative side sufficiently to insure safe operating conditions; and that we would be wise to defer expenditures as far as practicable without hampering too seriously the progress of the industry.

Our final judgment was based on the following conclusions: (*a*) that a turf surface could be maintainable over the greater part of the field for some years to come, but that those portions of the field subjected to heaviest traffic would shortly have to be oil treated; (*b*) that impermeable surfaces should be placed on parts of the field—namely, probable areas of building development, including hangars and industrial structures; roads serving these buildings; a service apron extending the full length of the hangar site; and four runways 200 ft. wide and averaging 3,500 ft. in length; (*c*) that runoff from the paved areas would amount to 90-100 per cent and that runoffs from bare soil and turf-covered areas would approximate the amounts determined for such conditions in research work done several years ago. It was concluded that a proper policy would involve the taking off of a one-year-frequency rain very nearly as fast as it falls, and that it would be undesirable to have water remaining on the field surface longer than two hours.

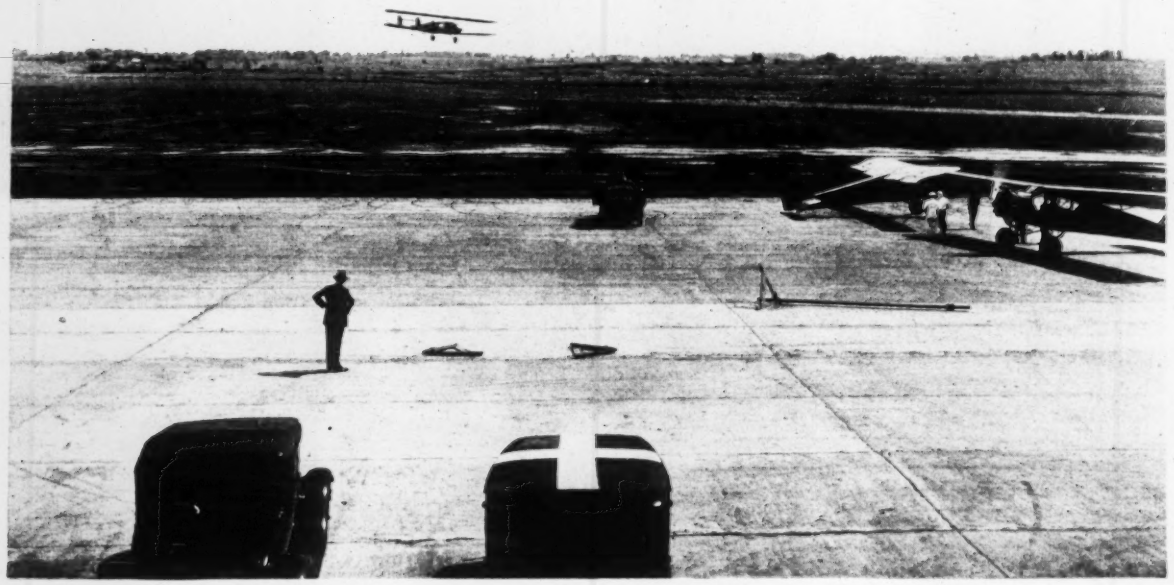


FIG. 4—CONCRETE APRON AT ST. LOUIS MUNICIPAL AIRPORT
Note rockfilled ditch at toe of apron and beyond the freshly oiled earth.

It was decided to design the drainage system on this basis, which was quite comparable to what would be used in a stormwater sewerage system, it being evident, of course, that any such system, if large enough to carry off rainfall as it fell, would be ample to serve also as main drainage or outlets for a system of tile drains.

We could find no record of any scheme or design covering the conditions outlined and were finally forced to make an extended research on a mass-time basis of the movement of water from a rainfall of this character. This work was carried out by E. E. Bloss and Clarence Miller, civil engineers of the department, in rather careful detail for a typical 30-acre unit. It involved studies of the effect of storms of different intensities and durations in flowing through a provisionally determined system. The study required computations, at

ten minute intervals during such a storm, that would show instantaneous rates of discharge and total discharge as compared with the amount of rain falling, the amount of water in surface film, the amount in storage in porous rock backfill and the amount in transit in drains. For this typical unit, a rain of about 45 minutes' duration seemed to give the most severe load, and a proper handling of the water with all allowances for storage and water in transit required a discharge capacity for the mains of about 0.42 cu.ft. per second per acre, or about 30 per cent of the rainfall rate.

On account of the great amount of detailed computation required, it was not considered practicable to go through such a study for each piece of design. Accordingly this rate of runoff was used for all similar areas and was modified somewhat for areas of other size and time characteristics.

The continuing development of a general field plan during and after the drainage work had been started has produced several conditions at variance with the original assumption as to type of surface, and further changes still possible indicate the futility of any application of extremely accurate methods to the design of this particular drainage system. However, in view of the immense amount of work of this character to be done throughout the country and the indications that a standard plan for airports will have been developed within the next year or two, it would seem highly desirable to continue research studies of this kind under more normal conditions where the engineer is not faced with the necessity for immediate construction. It would not be difficult to bring together pertinent information and to plan a scheme of application of these data to a rational design so that a sound engineering technique might come into being.

The main drains as finally laid out are shown on the accompanying plan. They were located in so far as possible to serve also as border drains or intakes for the heavy runoff of the runways.

In order to be sure to have ample intake capacity, all drain trenches are being refilled completely to the surface with coarse stone. It is expected that this filling not only will provide satisfactory inlet capacity for surface water but will so completely separate the intervening blocks of soil that the lateral movement of groundwater will practically cease. A special effort in this direction is made in connection with the lines surrounding the field proper. On two sides of this field there will be the new detour drainage ditch and on the remaining sides unusually deep storm drain lines refilled with stone. These latter lines will go down an average distance of 10 ft. It seems improbable that any great amount of soil water will pass

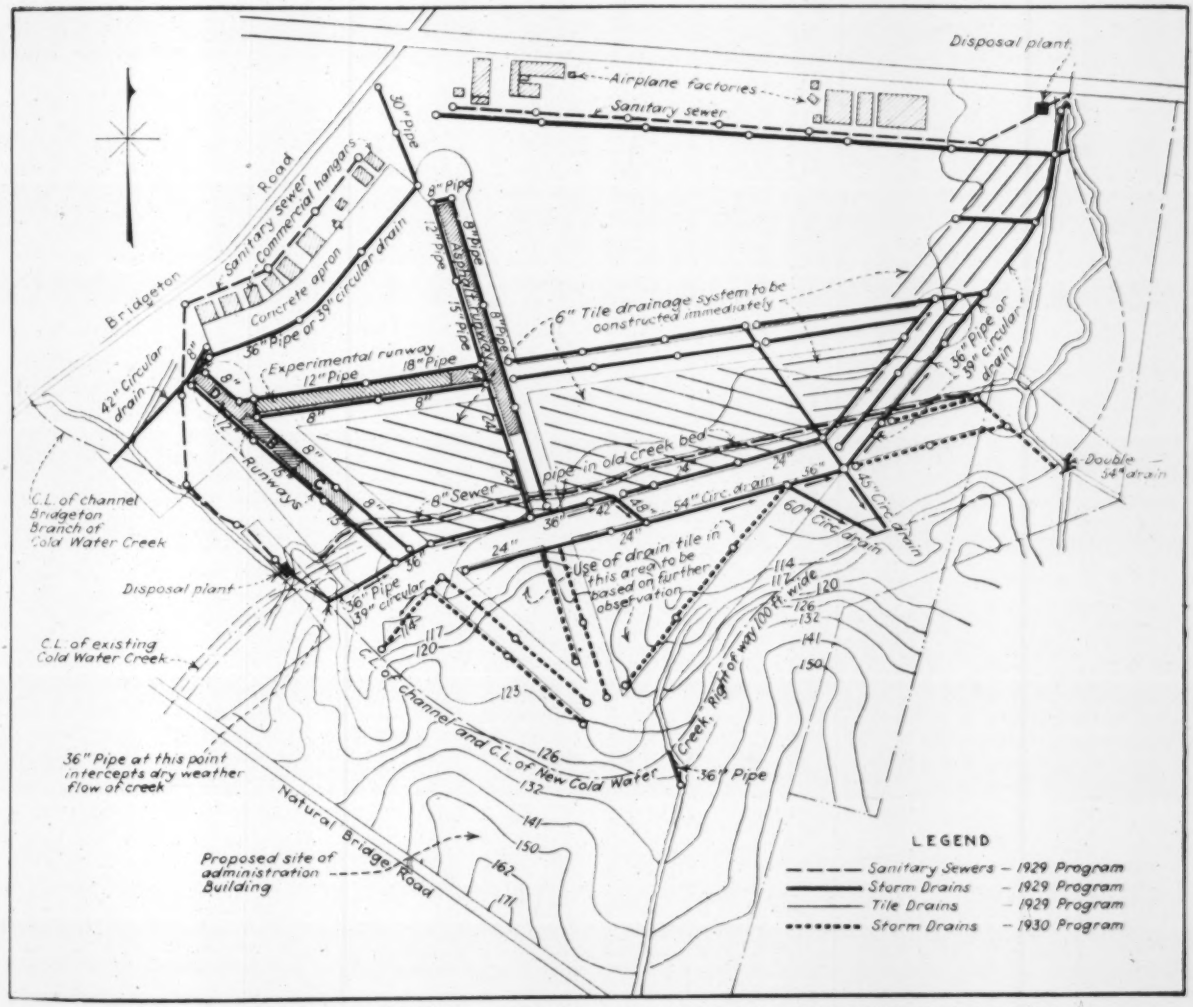


FIG. 5—FIELD DRAINAGE SYSTEM AND RUNWAY LAYOUT AT ST. LOUIS MUNICIPAL AIRPORT

into the field across those barriers, and this provision when coupled with a quick takeoff of rainwater through the stone-filled trenches will guarantee a relatively stable soil condition for the whole field. The soil itself is a silt loam, rather light in character except in the lowest part of the valley. When reasonably free from water, it has a high bearing value.

Runways

The character of the soil and the high stability which it was expected to secure through drainage justified, in my opinion, the recommendation of relatively light wearing surfaces for the runway areas, and the ease with which this soil could be pulverized indicated the propriety of an attempt to build up an asphalt-bound soil surface. Accordingly, a recommendation was made to the commission for the construction of an experimental section of runway of this type and an appropriation of $12,000 was made available. This experimental runway as finally built is 100 ft. wide and 1,200 ft. long. It was built in six sections, each of the full length and about 16 ft. wide. The binder in one section was tar and in the others asphaltic cut-backs and road oils from two different sources.

Before the work was started, an intensive laboratory research was carried out by Mark Thompson, asphalt engineer of the department, and ideas were secured as to the best types of bitumen, the percentages of bitumen required and the ease or difficulty of mixing the bitumen with the soil; experiments were also carried out in which stone was added, and the effect of the added stone in the mixtures was carefully studied.

The finished runways involved the use of nearly 50 per cent of stone graded from 1 in. down to sand. This amount of stone was too little to develop a stone asphalt pavement, but was valuable in assisting to break up the soil lumps and undoubtedly added some stability to the finished surface. Road oil was used as a primer and to safeguard the partly pulverized soil in case of rain. The actual binder incorporated in the soil was generally a mixture of about one part of road oil to two or three parts of medium cut-back, the road oil seeming to be of great advantage in keeping the mixture pliable after the lighter solvents of the cut-back had started to come off.

FIG. 7—ROLLING FIRST EXPERIMENTAL RUNWAY, ST. LOUIS

The experimental runway when finished had an average depth of about 3 in., contained a little more than 3 gal. of bitumen to the square yard and cost about 80c. per square yard, the cost being higher than normal because of the highly experimental character of the work and of frequent changes of method.

Because no definite subgrade had been established, fine finishing of the surface was not possible. The asphalt-bound earth mixture after final rolling was given a light seal coat and a covering of stone chips. The finished surface after final rolling is not as smooth as would be considered desirable and lacked the evidences of good workmanship to which the eye of the paving engineer is accustomed, but it has been in use for some time and shows no signs of being damaged by either tail skids or locked wheels. The pilots consider it highly satisfactory and are generally of the opinion that further smoothness of surface, if involving additional cost, would not be justifiable.

It was necessary to have short runways in other directions available before winter. As all of this work was considered experimental, the additional runways were also planned to make possible the observation of a variety of other light surfacings. The second runway to be built was to be of the highest type of light bituminous construction possible, and accordingly a hot-mixed pavement consisting of 3 in. of black base and 1 in. of sheet asphalt top mixture was chosen.

The third runway will include a small piece of concrete, and for this section a 6-in. slab reinforced with wire mesh and involving the use of six sacks of cement per cubic yard was designated. On the remainder of the third runway it was decided to apply the lessons learned in the first runway, and this is being done by

FIG. 6—FIRST ROUND OF MAINTENANCE AFTER OIL APPLICATION
This section of first experimental runway contained about 50 per cent of stone.

constructing two variations of the first experiment. The first variation, designated as section B, is an asphalt-bound earth mixture (without any addition of stone) 3 in. in thickness and covered with 1-in. stone asphalt top mixed in place under the common retread principle.

This section, besides requiring ½ gal. of road oil per square yard for priming the pulverized material and ¼ gal. for priming the base, involves incorporation of 2½ gal. of the mixture of cut-back and road oil. The bitumen is placed in four applications, and the careful working of each application is set out in detail in the specifications. The 1-in. retread surface will require from ½ to ¾ gal. of cut-back, including the amount for the seal coat.

The final section of the runway, known as section C, will consist of a 4-in. crushed stone pavement in which the stone is coated with asphalt and the voids filled with asphalt-bound earth. This pavement also will be built on

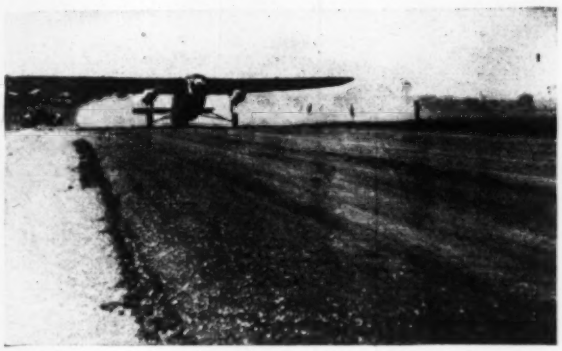


FIG. 8—FIRST RUNWAY AFTER SEAL COAT AND ROCK CHIPS HAD BEEN PLACED
Rockfill drain along edges not in place.

a carefully prepared and primed subgrade, and the rolled surface will be given a seal coat and a cover of chips. These last two runways are under construction and are scheduled for completion during November, 1929. There building this fall will serve the dual purpose of making available hard-surface runways for the coming winter and of making possible observation of the stability of the various light surfacings during the winter and the spring.

Summary

The full list of the runways is: First, the original experimental runway, about 3 in. thick, costing 90c. per square yard under experimental conditions, probably to be duplicated if desired again for 75c. per square yard, and probably the simplest and lightest form of construction which will ever be seriously considered.

Second, the hot-mixed pavement, full 4 in. thick, actually costing about $1.40 per square yard, probably not to be duplicated generally for less than $1.60.

Third, section B, a full 4-in. bituminous pavement in which the asphalt-bound earth is used to the greatest possible degree, costing 90c. per square yard.

Fourth, section C, a 4-in. asphalt macadam pavement in which the asphalt-bound earth was used for a filler, costing 99c. per square yard.

Fifth, 6-in. reinforced-concrete slab, costing $2 per square yard.

Finally, and to round out the series, a strip about 200 ft. wide and 1,500 ft. long adjacent to the apron was oiled with about 1 gal. to the square yard and heavily worked with the road maintainer. This strip is also being used as a runway.

Judgment on the propriety of any of these light surfaces for large-scale use is suspended until after the experience of the winter and spring can be analyzed.

In a general way we are spending a much greater amount for surface water removal than seems to have been the practice elsewhere. We are assuming that this will be justified not only by the prevention of standing ponds on the field but particularly by the greatly increased stability of the soil itself. If we are correct in this last assumption, we not only shall have secured a better condition of the field surface but shall also have been able to reduce our expense for runway surfaces from the $1.50 or $2 per square yard class down to the 75c. to 90c. basis. The saving, if applied to the full runway program, will amount to more than a quarter of a million dollars.

Following out the policy stated earlier, the construction of runways for the field will be stopped after the completion of the sections above described, which comprise possibly 20 per cent of the ultimate program. It appears now that the three 1,400-ft. runways will very satisfactorily care for all of the traffic immediately in sight. Also, a considerable part of the drainage is being deferred, subject to further study.

Sanitary sewers and some additional main drain lines will be put in this winter, but tile sub-drainage will be constructed only in the low section along the abandoned creek. Funds for further tillage will be held in the treasury until the effect of the large ditches and deep main drains has been determined. It does not seem impossible for the type of soil here present that the large drains 6 to 8 ft. in depth with full stone refill will lower the groundwater levels over very wide areas and may make inadvisable the construction of some of the tile drainage already contemplated. This problem is related to one of the other puzzles which will require study—that is, are we possibly putting in so much drainage as to have a seriously detrimental effect on turf culture? If we are, it might be advisable to provide fittings so that the underdrainage could be reversed into a sub-irrigation system.

Cleaning Up Streams in Cuyahoga County

Parts of Cleveland, Ohio, and all or parts of eleven municipalities outside of that city, together with some unincorporated areas, all within Cuyahoga County, are to be served by two trunk sewers, plans for which are noted in *Ohio Health News* of Sept. 15, 1929, as having been approved "recently." The first of these sewers, already under contract at a price of $293,000, will be from 42 to 66 in. in diameter, 9,500 ft. long, extending from an existing temporary outlet into Mill Creek to the southerly sewage works of Cleveland (see *Engineering News-Record*, July 12, 1928, p. 53). It will serve an area of nearly 22 square miles, including all or parts of Beachwood, Warrensville, North Randall, Miles Heights, Maple Heights, Garfield Heights and Cleveland. The second of the trunk sewers, estimated to cost $570,000 (contract not let), will be 21,575 ft. long, 36 to 66 in. in size, and will discharge into one of Cleveland's existing intercepting sewers, which now empties into Big Creek but which will be extended on to the southerly sewage-works. This sewer will serve an area of nearly 31 square miles. The two sewers, says the publication named, "will do much toward eliminating existing pollution of Mill Creek and Big Creek and will prevent future pollution of these creeks by sewage."

Lining Canals With Concrete on the Yakima Project

Half of 26-Mile Kittitas Canal Has 3-In. Lining—Drainage the Major Problem—Successful Method Developed for Holding Concrete on Slopes During Tamping

THE KITTITAS division of the Yakima project, U. S. Bureau of Reclamation, which includes 72,000 irrigable acres of land on both sides of the Yakima River in central Washington, is now well along toward completion. On Sept. 1 the main canal had been completed and work was well under way on the north branch canal, the south branch canal and the lateral systems under the main and south branches. Canal lining and drainage problems and the methods of solving them are described in the following. Construction of the inverted siphons which are notable features of the project will be described in a later article.

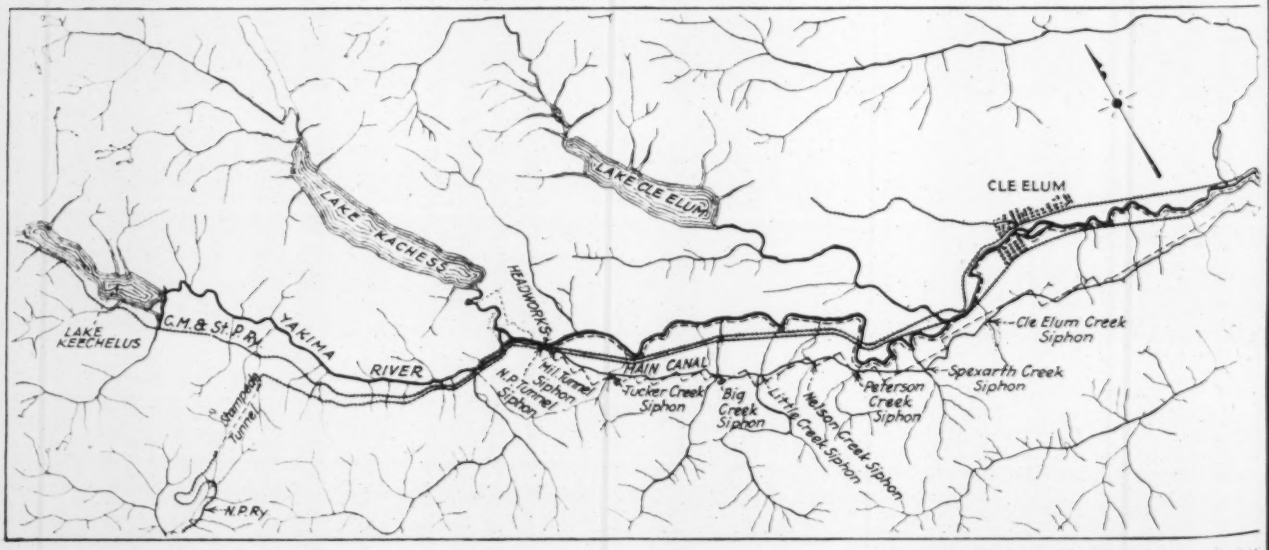
Decision to line about half the 26-mile length of the main canal with concrete, in general 3 in. thick, reinforced against temperature stresses, was made for reasons of economy and safety: (1) the lined canal of the specified capacity is smaller in section and (2) the lining is believed to be essential to prevent excessive seepage losses in some places and in others to give security on steep side hills. Every effort was made to keep the depth of fills to a minimum, and to gain this point the location follows a very tortuous route. The longest tangent is only half a mile in length.

A major problem was the drainage of lined sections to prevent upheaval of the lining by groundwater pressure when the canal is empty. To provide every facility for the escape of groundwater, drains were laid under the entire length of the lined canal and particular care was taken to prevent surface water from getting behind the lining.

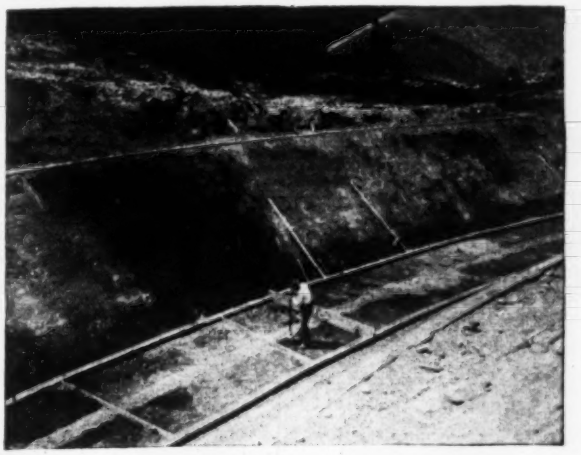
The longitudinal drains consist of bell-and-spigot pipe of clay or concrete, laid in trenches, overlain with gravel, and vented through outlets usually 300 to 800 ft. apart. The drain trenches were dug a minimum of 10 in. below the lining and were graded so that each outfall, usually set at right angles to the center line, would carry drainage from both directions. Longitudinal drains were laid with open joints, and in the outlets, which pass through the lower canal bank, the joints are cemented. At first the longitudinal drains were laid on the canal center line, but it was found more effective in reducing danger of uplift to put them under the toe of the slope at the upstream side. The drain sizes vary from 4 to 12 in. according to local conditions and length of the runs.

DRAGLINE EXCAVATING MAIN LINE CANAL
Berms were used on all through cuts exceeding 20 ft. in depth.

Provision for diverting surface water was made by sinking cutoff walls in swales above the canal and laying therefrom concrete troughs to discharge into the canal over the top of the lining. Where there was danger of groundwater below the top of the lining, gravel drains were laid in the canal side walls before the lining was poured. To keep the gravel in place on the 1¼:1 slope



LOCATION OF MAIN KITTITAS DIVERSION



CANAL SLOPES TRIMMED TO GRADE
Workman is tamping gravel in trench over drain. Note regularity of side slope finish.

and to prevent the drains from being choked with concrete, the gravel was plastered over lightly with a dry-mix mortar ahead of lining operations. On canal bottoms the gravel-filled drain ditches were covered with tar paper to prevent infiltration of dirt and of concrete during pouring.

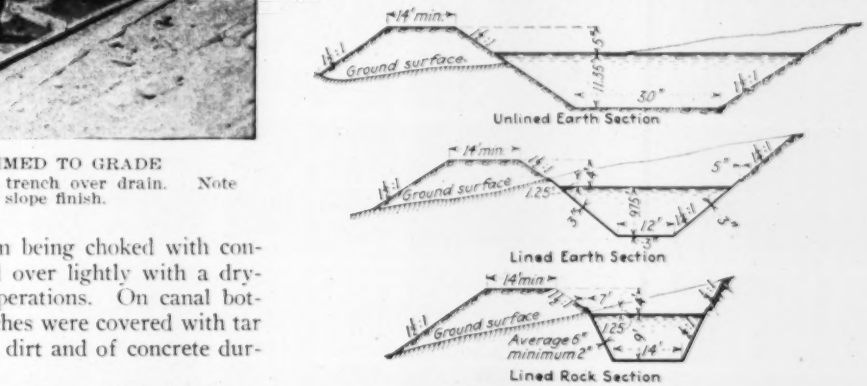
Despite the utmost care in carrying out these drainage provisions, groundwater did develop pressure under the lining in a few places, causing serious cracking. In one instance a section of the side lining 28 ft. long blew up and had to be replaced. Weepholes were drilled through the lining to relieve pressure along several sections of the canal.

It is the plan to have patrolmen note which weepholes are effective and to close permanently those that prove unnecessary. Those that are useful will be provided with pipes firmly grouted into the lining and threaded on the projecting ends so they can be capped during the irrigation season to prevent water loss.

By making the main canal curves as sharp as a 50-ft. radius (on center line), it was possible to keep the location in solid ground for about 98 per cent of the total length. In the few fills that were necessary, material was placed with the greatest care, being compacted either by the puddling process or sprinkled and rolled in layers not exceeding 6 in., using rollers weighing 2,000 lb. per linear foot. Wherever it was necessary to pour the side lining against fills—that is, wherever lining extended above original ground surface—the filling was made with the same care as was employed in filling under canal bottom. Berms 5 ft. wide 2 ft. above the top of the lining were used wherever through cuts were more than 20 ft. deep.

Excavation was made with power shovels, draglines and clamshells. The shovels were used principally to prepare benches along the steep side hill on which the draglines could travel and to remove material in the rock cuts. Ordinarily, the canal section was dug by draglines working from a position near the center line of the canal. In several cases, on account of the depth of cut and height of spoilbanks, the dragline made two trips—down one side and up the other.

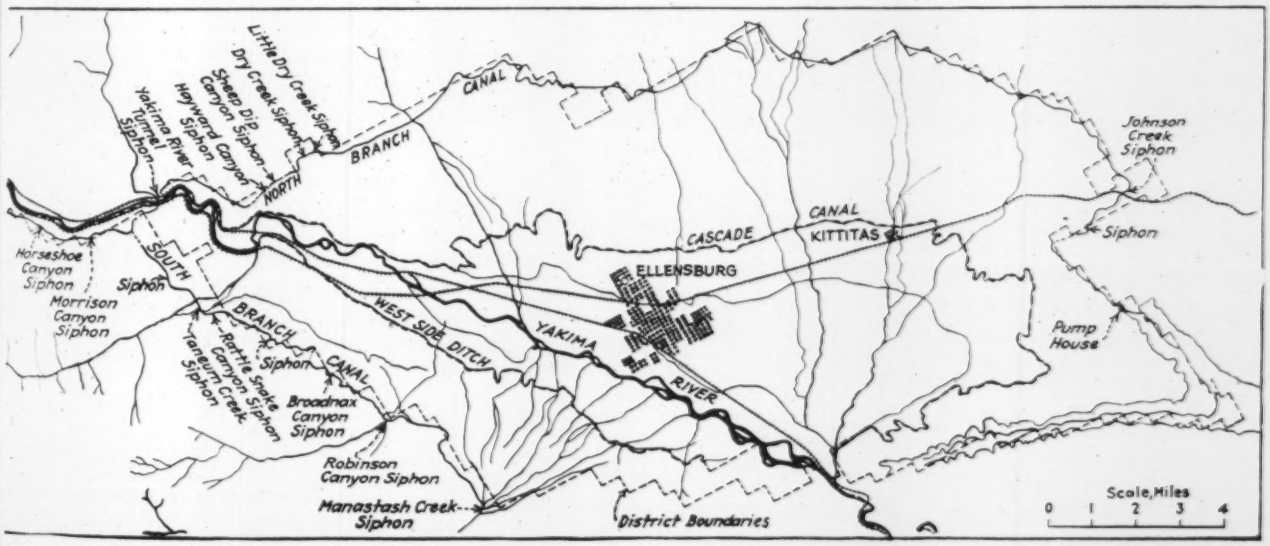
In one instance two draglines were used to excavate one of the largest cuts. The first cut, to an elevation 2 ft. above the top of concrete lining, was made by a machine with an 85-ft. boom and a 2½-cu.yd. bucket, operating along one side of the cut. This finished, a dragline



Hydraulic Properties of Canal

Type of Section	Area Sq.Ft.	Velocity Ft. per Sec.	Flow Sec. Ft.	Hydraulic Radius (r)	Friction Coefficient (n)	Slope of canal bottom
Unlined earth	534	247	1320	749	00225	000009
Lined earth	236	560	1320	546	0014	00003
Lined rock	1665	765	1275	488	0014	000065

TYPICAL SECTION OF KITTITAS MAIN CANAL, YAKIMA PROJECT



CANALS AND SIPHONS, YAKIMA PROJECT

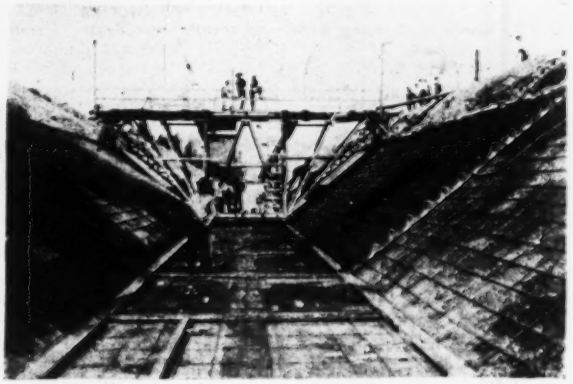
A SECTION OF CANAL BEING CURED UNDER BURLAP
In some places where the water supply permitted, sprinklers were used for curing.

with a 60-ft. boom and a 1-cu.yd. bucket was put in the bottom of the excavation to complete the canal section to grade. The smaller machine, taking material from the canal section, deposited it where it would be in the path of the larger machine while on its second trip to finish excavation along the opposite side. Clamshells were used to remove material from the bottom of the canal resulting from trimming operations to prepare the slopes for concrete lining.

After the canal section had been roughly trimmed to slope stakes by the power equipment, a 3x8-in. header was set along the top of the slopes to mark the limits prescribed for the lining. Running at right angles to this header, 2x4's were then set in each slope 10 to 16 ft. apart, according to the contractor's preference, and men with shovels and a screed board worked down the slope and trimmed it to grade. With a little experience this method made it possible to get the sides of the canal trimmed exactly to a $1\frac{1}{4}:1$ slope. After this had been done, the slopes were kept sprinkled until the concrete was poured to prevent the surface from drying out and blowing away.

Temperature steel for the 3-in. lining consisted of $\frac{3}{8}$-in. round deformed bars on 24-in. centers transversely and 12-in. centers longitudinally, supported from bottom and sides, so as to be centered in the lining, by small concrete blocks. Splices were 18 in. in length and were staggered.

The mixing plant was set up on the roadway maintained on the lower bank of the canal and was moved along as the work advanced. Concrete was chuted directly from the mixer to the near slope or delivered in hand buggies by means of a movable bridge to chutes



CANAL SECTION READY FOR LINING
Bridge for concrete buggies in background. Headers on bottom are removed as pouring advances.

serving the bottom and the far slope. The side slopes were placed simultaneously, working from the bottom up. The floor was placed immediately after the side slopes had been completed, the planks on which the movable platform, or jumbo, traveled having been removed as soon as the jumbo was in position at the next panel. A 14-ft. length of the lining, both sides and bottom, was completed in each pour.

A feature of the canal lining operation was a device that served both as a working platform and as a top form for placing concrete on the side slopes. This included a steel panel about $3\frac{1}{2}$x14 ft. in size supported at either end on light steel trusses on which it could move up the slope as the work progressed. A crew of three men working on this panel tamped the concrete firmly in place beneath it and moved the panel up the slope when necessary. The weight of the form, loaded with equipment and crew, was enough to make it possible to tamp the concrete vigorously without danger of causing sloughing. The form was adjusted by jacks at either end of the light steel trusses, to allow for the exact thickness of concrete desired. The trusses were held firmly as part of a rectangular frame by I-beams at the top and bottom of the side slope.

This method of tamping the slopes was found to be highly satisfactory, particularly because of the greater degree of impermeability thus secured. The resulting concrete is considered by those in charge as superior to that obtained where the ordinary method of placing concrete canal lining is used.

To date 24 major contracts have been entered into in the construction program, twelve of which have been

DEVICE FOR HOLDING CONCRETE ON SLOPES DURING TAMPING
Note light steel trusses beneath steps. Jacks and winch adjust position.

completed. Contracts including canal lining operations described herein were carried out by the General Construction Company, of Seattle; the Derbon Construction Company, of Seattle, and S. H. Newell & Company, of Portland, Ore. The project is being built under the immediate direction of Walker R. Young, construction engineer, U. S. Bureau of Reclamation.

Earth Dam With Spillway Channel Through Embankment

Concrete-Lined Overflow Channel — Effects of Settlement — Clay Core Wall Has Steel and Wood Sheeting

THREE special features of an earth dam completed in 1928 for the water supply of Mitchell, S. D., are its construction on the natural soil, its core wall and its spillway. In the clay core wall there is a cutoff or diaphragm of combined steel and wood sheeting. The spillway is formed as a channel through the dam, protected by a concrete floor and walls. Some criticisms of the design are noted later.

History of Project—A new water supply from Firesteel Creek has been proposed at different times, and in 1925 a reservoir project was planned by S. H. Smith, then city engineer. Its cost was estimated at $400,000, including the dam, land, pipe line, pumping station and filtration plant. A bond issue of $350,000 was approved by public vote, it being expected that the state Fish and Game Department would pay $50,000 on account of the creation of an artificial lake. This project was not carried out, and the bond issue was canceled later. Revised plans were submitted by Mr. Smith in 1927, with an estimate of $405,000 (of which $125,000 was for earth dam and concrete spillway); of this total the Fish and Game Department was expected to pay $75,000. A bond issue of $350,000 was again voted. The city then engaged a firm of consulting engineers, whose report estimated the cost of the earth dam and concrete spillway at about $400,000.

As this cost for the dam alone exceeded the amount of the bond issue for the entire project, the city then had an investigation made by J. E. Kirkham, consulting engineer (and formerly bridge engineer of the state Highway Department), Hot Springs, S. D., to see what could be done with the funds available. He reported that a satisfactory dam could be built for $132,317 and his plan was adopted. The contract was awarded to T. J. Tobin, Madison, S. D., at $115,051; the next lowest bid was $124,994. However, some changes were made during construction and Mr. Kirkham gives the cost of the completed dam as $131,951. The dam was completed in October, 1928, and the reservoir was filled to overflowing in March, 1929. This reservoir is about 4 miles long and half a mile wide, with a maximum depth of 38 ft. and a capacity of 2,800,000,000 gal.

Construction of the Dam—The Mitchell dam, about ¼ mile north of the city, is ¼ mile long and 40 ft. high above the bed of the stream. Its top is 30 ft. wide and is to be covered with a concrete roadway. On the upstream side, the slope begins at 1 on 1¾ to the low-water level (this part being paved for about 3 ft.) and is then 1 on 3, increasing to 1 on 10 at the base across the creek bed, a distance of about 250 ft. On the downstream side the slope is 1 on 1½. Cross-sections at the spillway and in the body of the dam are shown in Fig. 1.

In his investigations Mr. Kirkham found satisfactory clay for the fill in the hills at both ends of the dam, while extensive borings showed similar material across the valley, except for a few feet of surface soil. He concluded that it would not be necessary to excavate the site to bedrock, since the natural material was as good as the artificial fill would be. There were, however, strong springs, apparently from the underlying chalk rock, but these were piped to the downstream toe. It was decided to cut a trench down to the solid clay, under the upstream

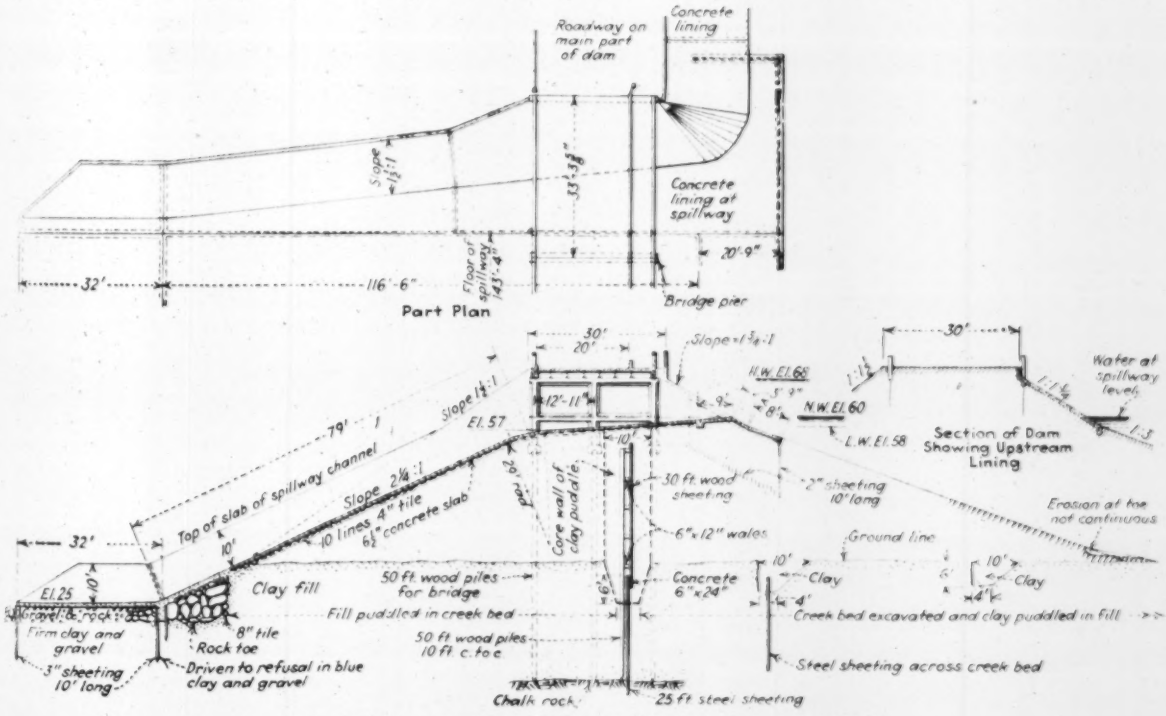


FIG. 1—TYPICAL CROSS-SECTIONS OF DAM AND SPILLWAY

slope, and in this to drive a continuous line of steel sheetpiling across the valley, in order to guard against seepage due to sand pockets and also to shut off the springs so that they would not cause damage to the lower part of the puddled clay core wall.

This core wall, under the crest of the dam, is 10 ft. thick, narrowing to 5 ft. at the bottom of the cutoff trench. In this trench was driven a line of 25- and 30-ft. steel sheeting, penetrating well into the rock. This was backed by a row of 50-ft. wood piles spaced 10 ft. center to center and driven to rock. A concrete beam 6x24 in. was built along the top of the steel sheeting, and above this was 25-ft. wood sheeting spiked to 6x12-in. wales on the wood piles. This latter sheeting consisted of 3x12-in. planks having 2x6-in. strips nailed to them to form tongue-and-groove joints. It extends up to about the spillway level and is designed to distribute horizontal pressure in case of uneven settlement and also to prevent muskrats from boring through the dam, as their teeth cannot get hold of the flat surface.

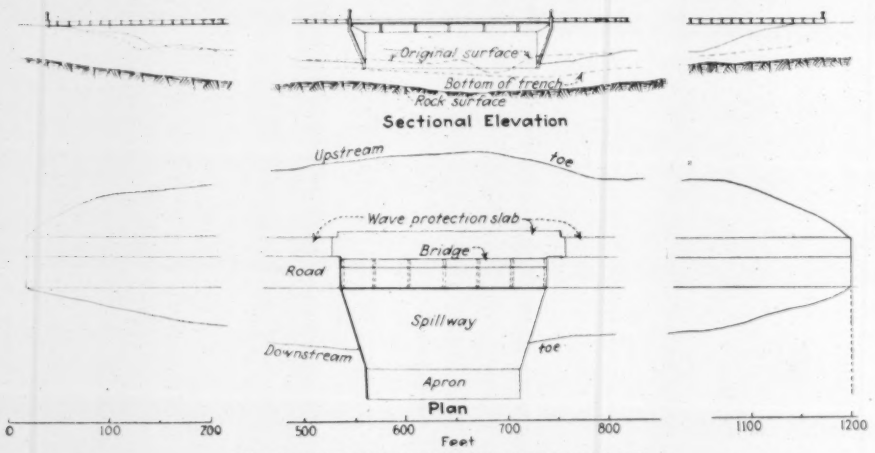


FIG. 2—DAM WITH SPILLWAY IN MIDDLE

The bed of the creek was excavated to solid clay and then filled with clay puddle, which was also placed in two cutoff trenches under the upstream slope. After the surface soil had been removed from the base area of the dam, the filling of moist clay was deposited in 6-in. layers by means of dump wagons and was rolled with an 8-ton roller, each layer being wetted with water from a hose. Concrete paving 6 in. thick, for wave protection, is laid on the upstream side, from the top to about 3 ft. below an assumed low-water level. Its upper end is anchored to a row of 4-in. I-beam posts, 14 ft. long and spaced 8 ft. center to center, which carry the railing along the highway over the top of the dam. This paving extends to a greater depth at the spillway, as noted later.

Erosion of Dam—By January, 1929, light rains had given 4 to 5 ft. of water in the reservoir. Heavy winds caused waves which began to cut away the face of the dam, in some places as much as 2 ft. Apparently no effort was made by the city authorities to protect the earth slope, although Mr. Kirkham states that he had warned them to watch it while the lake filled and to protect it with a layer of swamp hay or a log boom if necessary. However, the city hauled in some earth. As the thickness of the dam at this level was more than 200 ft., he saw no danger in the erosion and did not consider that it would be necessary to pave the entire depth of the slope, as the city afterward suggested. Since the slope is quite flat at the bottom, no slip was likely to occur, and he states that no erosion occurred at higher levels as the water rose.

There have been a slight seepage and some settlement in the body of the dam, but Mr. Kirkham states that neither of these is serious and that they are less than had been expected. The water piped from the springs under the dam carries no silt.

Spillway—After considering different locations for the spillway, all of which proved unsatisfactory, it was decided to form it as a part of the dam, as shown by Figs. 1 and 2. Its channel has a bottom width of 143 ft., with side slopes of 1 on 2½. The crest is 10 ft. below the top of the dam. At the spillway the fill was rolled and puddled with special care in order to reduce shrinkage and settlement to a minimum. This fill is protected by a concrete slab floor so designed as not to be damaged seriously by ordinary settlement. To accomplish this the slab was made only 6 in. thick, reinforced in top and bottom with welded wire netting of 4-in. mesh, with ¼-in. wires, thus making it sufficiently flexible to deflect with any settlement beneath it. Under the slab were ten lines of 10-in. tile to take care of seepage, delivering the water into a rockfill under the toe of the dam; in this rockwork was laid an 8-in. drain parallel with the toe and turning out into the creek channel on each side of the spillway.

On the upstream side the concrete slab extends about 5 ft. below the crest (11 ft. 9 in. measured on the slope) and its toe is formed as a cap on a row of 2-in. wood sheeting 10 ft. deep. This sheeting is carried back along the sides of the spillway channel. From the crest, the spillway floor has a slope of about 1 on 16 through the top of the dam, changing then by a vertical curve of 29-ft. radius to the slope of 1 on 2¼ which extends to the toe. Here the concrete extends over the rockfill provided for drainage. Beyond this is an apron 32 ft. long with a concrete slab on a bed of stone and gravel. Both edges of the apron are protected by cutoff walls and 3-in. wood sheeting 10 ft. deep. The sides of the spillway channel are faced with concrete to a height of 10 ft.

For the highway bridge across the spillway, wood piles are driven to rock to carry the footings of the concrete abutments and column bents. There are six spans of 33 ft., consisting of I-beam stringers carrying the concrete deck slab.

Settlement of Spillway—Early in July, 1929, settlement occurred over a considerable area of the spillway and there was erosion around the edges of its slab on the upstream slope. This condition naturally caused some public agitation, and an inspection was made by Mr. Kirkham, together with the present city engineer, J. C. Scallin. The former reported that it was not serious and that it looked worse because the slab had not been left free from the bridge columns, so that it did not deflect with the fill, as had been intended. Water collected under the slab and a wash occurred at one point, but this soon stopped, as the earth could not move after filling the few depressions. He saw no evidence that the fill had moved bodily. It was considered an easy

gutter, therefore, to level the fill and adjust the slab by forcing grout to seal any voids under the slab.

Repair work at the spillway has been carried out under the direction of the Caldwell Engineering Company, Jacksonville, Ill., which is now building the new water-works. About 30 holes were cut through the bottom slab at various points, and it was found that the earth underneath had washed a gutter with a depth of about 3 ft. at the top of the spillway and then decreasing. In the upper part of the spillway, along the crown of the earth structure, where the slab hung to the bridge columns, the settlement varied from 3 to 6 in., leaving the slab unsupported. To compensate for this settlement, a lean mixture of sand and cement was forced into the space underneath the slab by a grouting machine operating under about 125-lb. air pressure. If further settlement takes place, this grouting may be repeated, but Mr. Kirkham doubts that this will be necessary.

Criticism of Design—When the present project was accepted, the design of the dam was criticised by Mr. Smith, then city engineer, and he resigned in order to have no connection with the work. One point of criticism was that the concrete paving for wave protection on the upstream face was not extended far enough down the slope, since the high rate of evaporation and the draft of water would lower the water level several feet during a protracted dry period. He recommended that the paving should extend at least 3 ft. below this probable low-water level in order to prevent erosion which might result in damage to this facing above it and so cause heavy maintenance costs. The rolled-fill spillway with concrete slab cover was also criticised, as two spillways of this type were said to have failed; one in a 30-ft. dam at Valentine, Neb., and the other in an 18-ft. dam at Tiffin, Ohio. In view of records of high water in the creek, which would back up water for 10 or 12 ft. on the downstream side of the dam, he considered that the 1 on 1½ slope should be flattened for at least this height and protected with paving or riprap, while the remainder of this slope should be covered with 12 in. of black earth and then sodded or planted with suitable vegetation to prevent wash.

Present Conditions—After making his inspection Mr. Kirkham, as the engineer responsible for the design of the dam, has reported that the damage is slight and that there is no dangerous condition in the dam itself or in the spillway. Settlement or shrinkage is less than he had expected; seepage is slight and erosion is negligible. It is his opinion that dressing the fill at the spillway and leveling by grouting under the concrete floor will effect permanent repair at small expense. Certain cracks in the spillway abutments which attracted attention are said to be nothing more than surface checks.

Designing Flush Fire Hydrant for Cincinnati

A flush type of fire hydrant for use in the central business districts of Cincinnati at the outset, and ultimately throughout the city where pedestrian traffic is interfered with by sidewalk construction, is being designed by J. A. Hiller, superintendent of water-works, at the request of C. O. Sherrill, city manager. The new hydrant will be controlled by a single valve, giving a free flow of water from valve to outlet. It will be with provision for a portable connection, similar to the connection already used with high-pressure hydrants in Cincinnati. At present Cincinnati has no flush hydrants in use, the 6,000 fire hydrants in service being all post hydrants.

Parkersburg Removes CO_2 From New Well-Water Supply

Each Well Has Pump Within Driven by Motor Above It in Extension of Casing—Aeration by Spray Nozzles Provided

By Myron G. Mansfield
Of Morris Knowles, Inc., Pittsburgh, Pa.

ALTHOUGH located on the banks of the Ohio River, the city of Parkersburg, W. Va., has just solved its long-standing problem of providing an adequate and satisfactory water supply by the installation of a new well system and the construction of a carbon dioxide-removal plant. Unfortunately, the question has been involved politically as well as technically for several years.

Raw Ohio River water was the source of supply until typhoid fever became prevalent in 1907. Studies

AERATOR FOR REMOVING CO_2 FROM WELL WATER AT PARKERSBURG, W. VA.
There are 42 nozzles of the Sacramento type, mounted above a concrete collecting slab.

were made by several engineers, some of whom recommended a well supply and others a filtered water supply. Construction of filtration works was authorized by the city council in 1911, but an injunction suit prevented the further expenditure of funds. This was followed by the installation of a system of manifold pipes and strainers laid in the bed of the Ohio River, which became more or less inadequate in 1918. In 1924 the alternative of wells or a filtered river supply again arose, resulting in the defeat of a bond issue for filtration works. In 1925 a bond issue for filtration works was again defeated. At the same election preference for a well supply was expressed by a four to one vote.

Three wells were drilled in the latter part of 1926 and the early part of 1927 to furnish an emergency supply. This was followed by an engineering report which resulted in the installation of nine additional wells in 1928 and the re-equipment of the three temporary wells. The wells have a nominal 38-in. diameter, are gravel-packed and are equipped with motor-driven centrifugal deep-well pumps. They were located in a single line along the east bank of the Ohio River about 300 ft. apart. They are about 60 ft. deep and extend to water-bearing gravel overlying bedrock. The casings project approximately 20 ft. above the surface of the ground and are incased in concrete, forming a column

or pedestal which supports the superstructure for housing the motors. From 40 to 100 cu.yd. of graded gravel was used in each well. Casings are watertight and pump motors are located above the recorded maximum high-water level, so that contamination or interference in operation will not be probable. The wells are all connected into one collecting main, ranging in diameter from 16 to 24 in., which leads to the carbon dioxide-removal plant and pumping station. The minimum combined yield of all wells was more than 6,000,000 gal. daily during a 30-day test made at the end of the dry season of 1928.

The design and construction of the wells are described in more detail as follows: The walls consist of a 38-in. casing within which is an 18-in. pipe. On the lower end of this pipe a screen 10 ft. long, flared out at the lower end to a diameter of 30 in., is fastened. In drilling a well, a 10-in. hole is first made with a rotary drill. This is gradually enlarged by side cutters until a final diameter of approximately 42 in. is secured. A 38-in. casing is then suspended in the hole so as to project just into the gravel stratum, lined up and held in place by washing gravel down around it until the surface of the ground is reached. The 18-in. steel pipe

ELECTRIC-DRIVEN PUMPS WITH MOTORS MOUNTED ON WELL-CASING EXTENSIONS

and screen are lowered into the casing and at the same time the well is baled and agitated with a plunger. While the screen is being lowered into place, ⅛- to 1-in. graded gravel is washed in around the 18-in. pipe and screen. This operation is continued until the strainer is forced down through the sand and gravel strata and rests upon rock. As the original material is loosened up and removed, it is replaced by gravel, forming a wall several inches thick around the strainer, thus retaining the sand and permitting a free flow of water toward it. After the strainer is in its final position, the bottom is sealed by a concrete plug.

With the selection of a well system as a source of supply, there arose another problem as to the type of treatment necessary, if any. Analyses of various well waters in the vicinity showed the water to be high in free carbon dioxide and in some cases relatively high in iron. Tests of water from the wells as drilled showed lower iron content than those first studied, and this resulted in delaying the construction of the iron-removal plant originally contemplated.

A carbon dioxide-removal plant, however, was constructed with provision for the addition of chemical at any time and later for the expansion of the plant to include rapid sand filter units when found necessary for complete iron removal. The plant (*as built*) includes spray-nozzle aerators, a chemical dry-feed machine and a chemical mixing chamber, a clear-water well, a pumping station, an office and a laboratory. The aerators consist of 42 Sacramento-type spray nozzles located over a concrete collecting slab which is constructed above the elevation of high water in the river. The total capacity of the aerators is 6,000,000 gal. per day.

As designed, water was to flow from the aerator to a twenty-minute detention mixing chamber, provided with a mechanical agitator. The chemical was to be supplied by a dry-feed machine. Provisions were made for the addition of filters later on. Tests, with lime as the chemical, were made to show what iron removal could be effected by the use of this agent, without filtration. They indicated that lime treatment alone would not be warranted, unless perhaps when the iron is very high.

As operated, water is pumped from the wells through the spray nozzles, falls onto the collecting slab, and flows to a 140,000-gal. clear well. It is then pumped to the distribution system by motor-driven centrifugal pumping units of 2,000,000 and 4,000,000 gal. daily capacity. All well pumps are controlled by push-button switches located in the pump room, including a signal system to indicate the particular wells in operation.

The wells, well-pumping equipment and motor-driven high-lift pumps were installed by the Layne Atlantic Company, of Norfolk, Va. The carbon dioxide-removal plant was constructed by A. Phelps & Sons, of Detroit, Mich. Design and supervision of construction were carried out by Morris Knowles, Inc., consulting engineers, Pittsburgh, Pa. Councilman George Huber is superintendent of water-works and sewers.

The plant has now been in operation for nearly a year with very satisfactory results, the free CO_2 content being reduced to approximately 6 to 8 parts per million and the iron content averaging from 0.2 to 0.3 part per million. The water consumption of Parkersburg now averages about 2,900,000 gal. per day.

New York City Appoints Commission to Study City Noises

What is believed to be the first official commission in the United States to study the problems created by the noise of the modern city has been named by Health Commissioner Wynne of New York City. Included in the seven members are Lewis H. Brown, president of the Johns-Manville Corporation, and Harvey Fletcher, research engineer of the Western Electric Company.

In appointing the body, the Commissioner suggested that its work be divided into the following divisions: (1) the possibilities of reducing noise through the enforcement of existing ordinances; (2) a complete classification of noises, including the scientific measurement of the principal city noises and recommendations for their control; (3) a scientific statement of the effect of noise on the human ear; (4) recommendations as to what constitutes the border line between inevitable and unreasonable noise; (5) an investigation of sound-absorbent construction for buildings; (6) experience of other cities in noise reduction; (7) what additional laws are necessary to govern the noise situation.

Lag Between Financing and Awarding Analyzed

Time Difference Is About Four Months on the Average, but Not for All Classes or for Every Year

BETWEEN financing and the award of the construction contract there is an average time difference of about four months. This holds for total construction and for some of its elements, but not for all classes and not for every year. This general lag has been analyzed, and the findings are presented here.

The Data—The contract figures are the statistics of engineering construction compiled regularly by *Engineering News-Record*. The finance figures are those compiled monthly by the *Financial Chronicle*.

For the purposes of this study the contract figures were arranged in seven series: (1) roads, (2) other public works, (3) total public, (4) privately owned buildings, (5) other private work, (6) total private construction, (7) total engineering construction. The accompanying table lists the values of each of these series for the years 1925-28 inclusive and for the first half of 1929, and gives the percentages that each series is to its group and to the grand total.

These percentages, both to group and to total, are remarkably uniform and confirm the fact that these series represent definite construction elements having quite constant weightings. There is some deflection in 1929, due chiefly to a heavy increase in private contracts for structures other than buildings and, to a much smaller extent, to backwardness in road lettings this year. This private group is double in value the figures for any other half-year, and 77 per cent of the $290,000,000 is accounted for by 24 projects costing in the neighborhood of $223,000,000.

The financing figures are in two series: (1) long- and short-term public bond issues, and (2) corporate domestic new capital issues, excluding refunding. These corporate issues are long- and short-term stocks and bonds

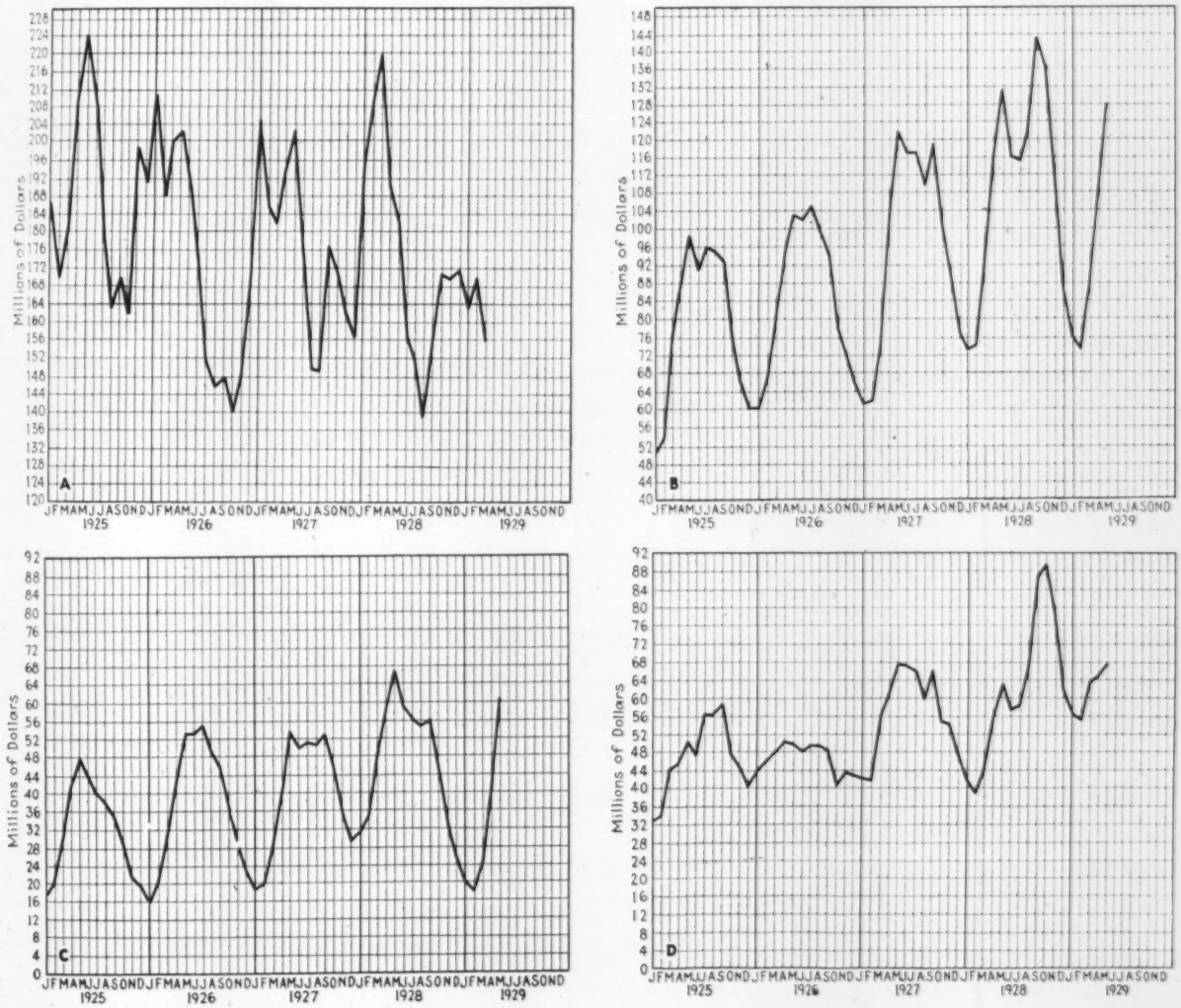
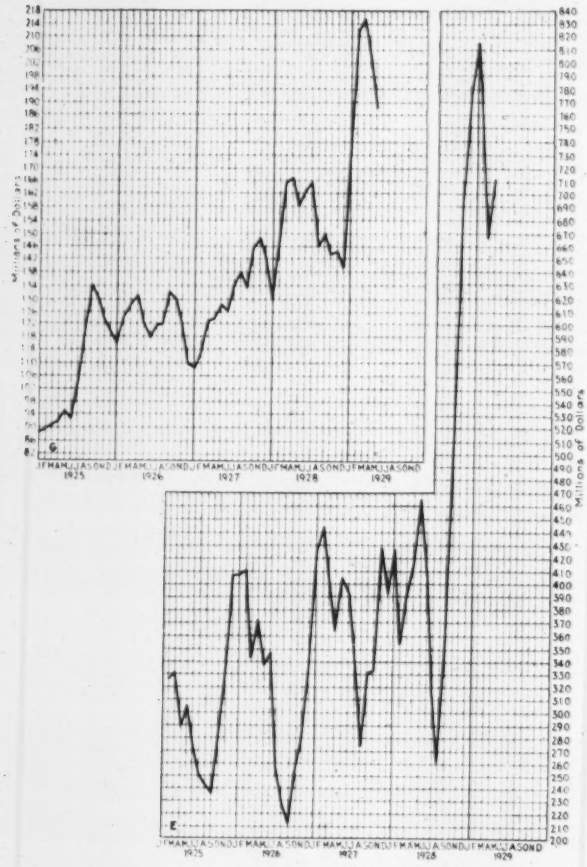


CHART I

Curve *A*, public bond issues. Curve *B*, total public contracts. Curve *C*, road contracts. Curve *D*, public except road. All three-month moving averages.

for railroads, utilities, manufacturing, metals, shipping and many other private enterprises.

Although some construction, principally dwelling-house, is paid for out of income, by far the greater part is financed by securities. As engineering construction is consistently around 40 per cent of all construction, it is reasonable to expect it to bear a fairly constant ratio to new capital. In the four years 1925-28 the ratio for private engineering construction was 42, 47, 43 and 41. There is less uniformity in the case of public engineering construction—46, 54, 60 and 67—due to the fact that a variable amount of public work is financed by other



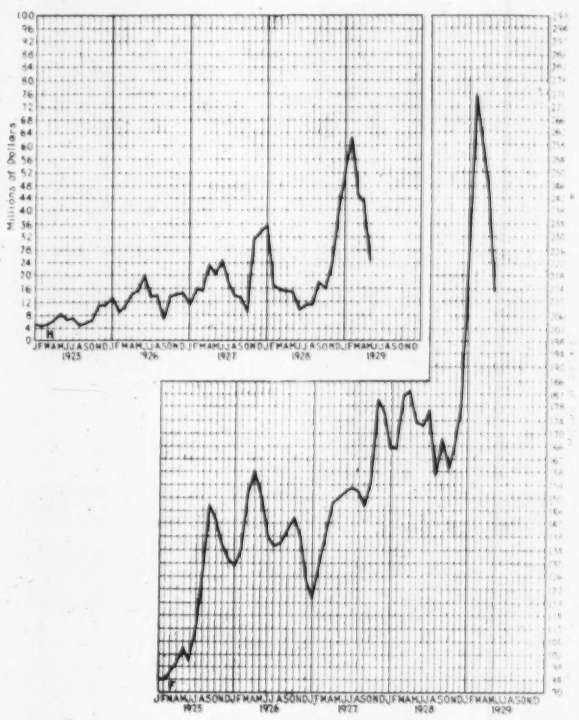


CHART II

Curve *E*, new capital issues. Curve *F*, total private contracts. Curve *G*, building contracts. Curve *H*, private except buildings. All three-month moving averages.

means than bonds. For example, roads (43 per cent of all public work) in 1928 received $301,000,000 from license fees, $278,000,000 from gas tax and some $75,000,000 from federal aid contribution.

In the accompanying two charts eight curves compare security issues with construction contracts.

Public Financing and Contracts—Public bonds and contracts, Curves *A* and *B* of Chart I, show a general lag of contracts behind financing of four months. This lag is not constant point for point, nor is it the same each year. In the five-year period studied, the four-month figure holds satisfactorily for 1926 and 1927. For 1925 the average lag seems nearer two months, though the characteristic winter slacks in work and financing are three months apart. For 1928 and 1929 the lag is clearly six months, the swings from the 1928 peak down and then up to the 1929 peak coinciding in both trend and amount.

The same regularity is seen also in the roads and streets curve, Curve *C*, Chart I. Road work being such a large branch of public construction, it is consistent to find the same time differences between this work and total public bond issues. The only exception is that the 1928 difference is four months, as is that for prior years, with six months for 1929. One reason for this two-months' shift is seen by examining Curve *D* (public work except roads and streets). Heavy lettings in this class in September, October and November, 1928, carried the peak of the total curve farther out to the right (toward winter) than in the case of road work, where the peak was in May. Except for this case, curves *D* and *A* show a time difference of four months; the 1928 shift to a lag of six to seven months is due in large part to the $42,000,000 Yonkers-Brooklyn water tunnel.

Private Contracts—Curves *E* and *F*, Chart II, show new corporate securities and private construction contracts. There is one commanding feature in each curve: the tremendous increases in both new capital and contract value at the beginning of 1929. The capital peak was reached in January, 1929, the contract peak in

VALUE OF CONTRACTS IN MILLIONS OF DOLLARS

	1925			1926			1927			1928			1929 (6 mos.)		
	Millions	Per Cent of Group	Per Cent of Total	Millions	Per Cent of Group	Per Cent of Total	Millions	Per Cent of Group	Per Cent of Total	Millions	Per Cent of Group	Per Cent of Total	Millions	Per Cent of Group	Per Cent of Total
Roads and streets	421	41	16	485	44	17	525	42	16	615	43	17	257	39	11
Other public	616	59	24	604	56	21	730	58	22	805	57	22	398	61	18
Total public	1,037	100	40	1,089	100	38	1,255	100	38	1,420	100	39	655	100	29
Buildings	1,404	92	55	1,589	90	56	1,719	86	55	1,951	90	55	1,295	82	58
Other private	118	8	5	176	10	6	280	14	7	207	10	6	290	18	13
Total private	1,522	100	60	1,765	100	62	1,999	100	62	2,158	100	61	1,585	100	71
Total eng. constr.	2,559	...	100	2,854	...	100	3,254	...	100	3,578	...	100	2,240	...	100

February. Before concluding that these similarly immense peaks indicate a phase difference of one month for these two series, the relative values of the monthly contributions to these peaks must be analyzed.

The capital peak was formed by a fair increase in September, two heavy and equal increases in October and November, a much smaller rise in December and a still smaller rise in January. The construction peak was formed by small increases in November and December, two heavy and equal increases in January and February, strong declines in March and April. These facts lead to the conclusion that the January-February contract boom is the reflection of the issuance of an unusual volume of capital in October and November.

Private Buildings—Curve *G* is too irregular to show a definite time trend in the short period covered. For the private work, however, comparison of curves *E* and *H* indicates an approach to a lag of four months.

Public and Private Financing—The seasonal character of financing becomes graphically evident when curves *A* and *E* are compared. As far as characteristics are concerned, the charts are interchangeable. In stating that they vary in amount, attention is directed to the extraordinary variation in the latter part of 1928. Corporate issues (increasingly common stock) in August-January mounted to unheard of values, while public bonds remained below the average level of the preceding years.

New Southwest Sewage-Works of Springfield, Mo.

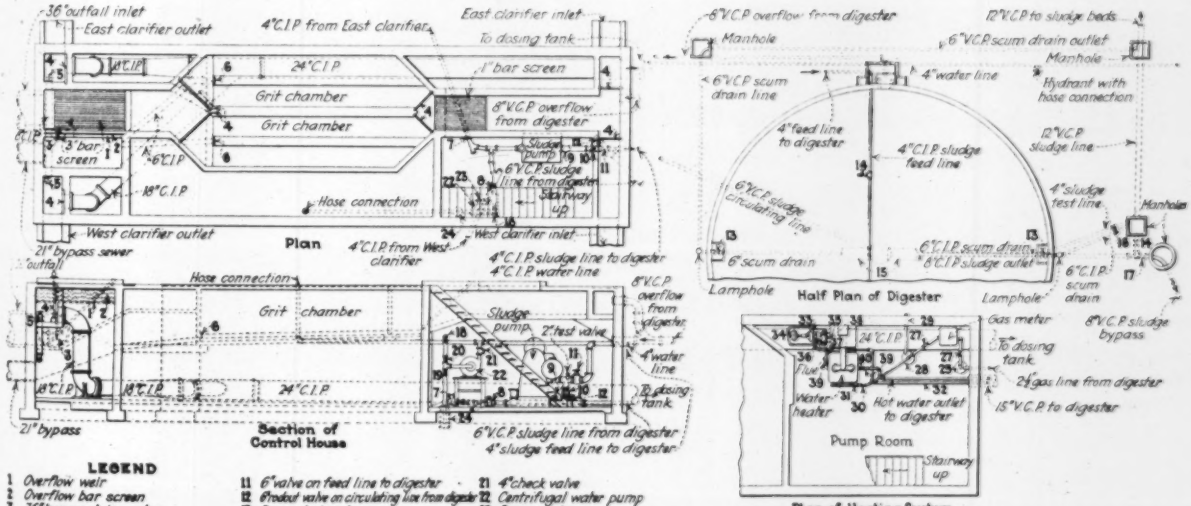
Gas Utilization and Operating Control House Chief Features of Plant Supplementing One Built Before World War

By George S. Russell
Of Russell & Axon, Consulting Engineers, Springfield, Mo.

THE principal features of interest in the clarification and filtration plant that constitutes the new southwest sewage-works of Springfield, Mo., are the equipment for collecting and utilizing gas and the location and arrangement of the control house for the entire works.

The plant is designed to serve 47,500 people. (There are two other plants, mentioned later.) Sewage enters the plant from a 36-in. outfall, passes through a 3-in. and a 1-in. screen, grit chambers, two 50-ft. square settling tanks equipped with revolving sludge scrapers, twin 25x30-ft. dosing tanks with 30-in. siphons and twin sprinkling filters 6 ft. deep and covering 2½ acres, and discharges into Wilson Creek, which has a very low minimum flow, probably less than the amount of treated sewage.

The gas-collection system consists of two gas domes in the sludge digester, and a heater to burn the gas and utilize it for hot-water heat both for the plant itself and for the digester. Both the sludge pump for pumping sludge from the settling tanks into the sludge digester and the heater are located in the basement of the control house, where are also the necessary appurtenances—such as gas meter, pressure regulator, drip pot and hot-water pumps. The digester is equipped with mechanism to aid in breaking up the scum and consolidating the sludge. Excessive scum may be piped to the sludge beds. The sludge pump is also connected with the bottom of the digester and is so arranged with valves that the sludge may be circulated from bottom to top or lime added at either point. It is hoped in this manner to provide for control of the sludge so as to maintain a uniform pH value. Provision is made for drawing sludge from the center of the tank as well as from its top and bottom. It is hoped that this flexibility will allow the plant to be operated so as to develop some interesting data on gas production and hydrogen-ion control.



LEGEND

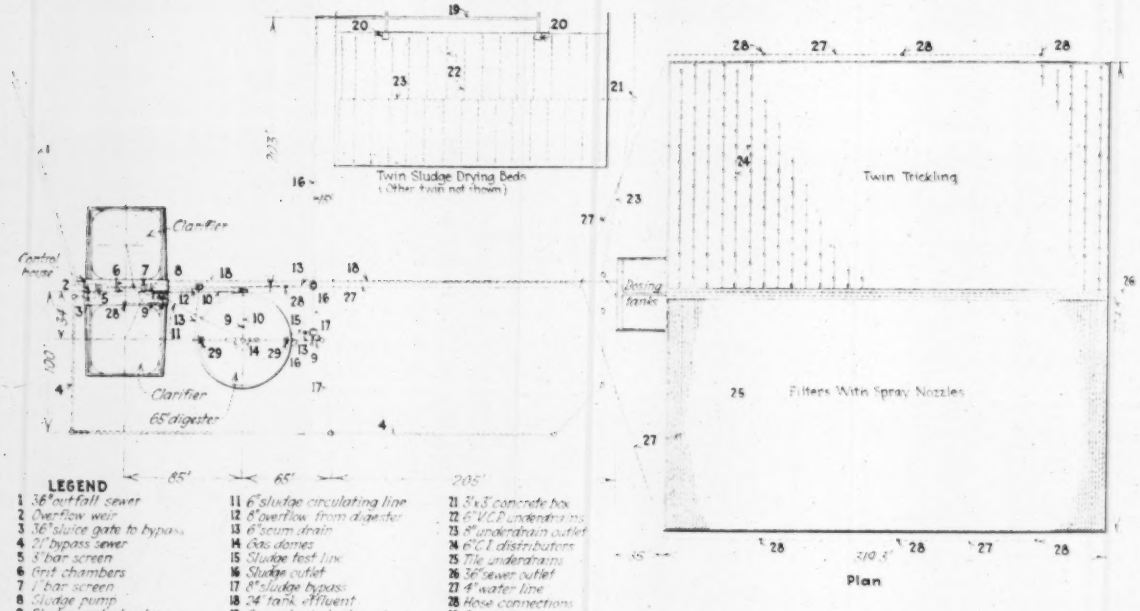
1 Overflow weir
2 Overflow bar screen
3 36" bypass sluice gate
4 Stop plank
5 8" plug valve
6 6" shear gate
7 4" valve on East clarifier line
8 4" valve on West clarifier line
9 6" valve on circulating line from digester
10 6" valve on pump line to bottom of digester
11 6" valve on feed line to digester
12 6"adout valve on circulating line from digester
13 Scum drain valve
14 Sludge control valve
15 Gas domes
16 4" valve on sludge test line
17 6" valve for sludge bypass
18 4" water line from clarifier to centrifugal pump
19 4" valve on water line from sump
20 4" valve on water line from clarifier
21 4" check valve
22 Centrifugal water pump
23 Pump motor
24 Floor sump
25 Gas drip pot
26 Gas regulating valve
27 Check valve
28 Pressure regulator
29 Relief pipe to atmosphere
30 Valve
31 Heater control valve
32 Hot water inlet from digester
33 Circulating pump
34 Pump motor
35 Valve on line to water meter
36 Water meter
37 Valve on water meter outlet
38 Valve on water line from pump to heater
39 Thermometer well
40 Expansion chamber

CONTROL HOUSE, SLUDGE DIGESTOR, SLUDGE-GAS BURNER AND HEATING SYSTEM FOR NEW SEWAGE-WORKS
Nearly all the operations of this plant are controlled in a small house between the settling tanks.

A coil of heating pipes is located in the bottom of the digester to promote bacterial action in the winter months. It is expected that sufficient gas will be developed to heat the control house. The decrease in size allowable in the digester, due to the fact that reduction goes on twelve months in the year, more than offsets the additional cost of heater, piping and gas collection.

Besides the equipment already mentioned as being located in the basement of the control house, there is also a wash-water pump which takes its water from mid-depth of the settling tanks to a water main with hose connections at convenient points around the plant. In the upper part of the control house are located the bypass valves, overflow weir, screens, grit chambers, etc., and in the two ells are located the sludge, and screen machinery. It was the purpose of this design to concentrate the operative features of the plant under one roof so as to make for efficient operation, particularly during the winter months. It is possible for the operator, without leaving this house, to start or stop all mechanism, to clean screens, to divert flow through the grit chambers or clean them, to operate one or both settling tanks, to control the flow to the dosing tanks, to bypass all or part of the sewage either before or after sedimentation, to pump sludge from tanks to digester or to circulate sludge and to keep a record of and operate the gas-collection system. In fact, everything necessary to a successful operation of the plant except drawing the sludge and cleaning the filter nozzles and underdrains can be done without leaving this house.

The filter beds are of the twin-feed type, the main distribution lines being 3x3-ft. concrete boxes built on the roof of the inspection gallery. The distribution laterals are 6-in. cast-iron pipes laid at the surface of the beds. These pipes are bossed and tapped so that the Taylor nozzles can be fitted into the pipe. For underdrains tile is used, 18 in. c. to c. These tile are continuous in line and grade from the inspection gallery to the outside of the beds, making it possible to lamp any line of underdrain and clear up any stoppage before pooling takes place on the surface of the bed. Having the underdrains open at both ends also affords ventilation of the beds. The filtered sewage collected by these drains is carried to the center gallery, where it finds its way into the main outfall or bypass sewer through ports spaced about 20 ft. apart. After entering the main sewer through these ports the sewage is discharged into Wilson Creek without further treatment. Hose connections are provided at convenient places near the filters so that the



LAYOUT OF NEW SEWAGE-WORKS OF SPRINGFIELD, MO.

Sewage passes through bar screens, grit chambers, second bar screens, settling tanks, dosing tanks and trickling filters. Before going to drying beds, sludge goes to separate digesters, from which gas is collected and burned to produce heat for digestion and for warming control house.

easy to flush out the underdrains as soon as there is any sign of clogging. The aggregate length of the drains is 13½ miles.

The sewage-works was built as a result of lawsuits brought against the city of Springfield on account of the condition of Wilson Creek and is intended to augment the old plant, mentioned later, and eventually replace it whenever additional units are provided.

Springfield, situated as it is on the divide between the Missouri River and the White River drainage, has no large near-by stream into which its sewage may be discharged. About 80 per cent of its population dwells on the south slope of the divide and the remainder on the north slope. Springfield is sewered by the separate system. In 1912 all of the sewers draining the south slope were joined to a single outlet and a sewage-disposal plant was constructed. This plant consisted of coarse screens, Imhoff tanks and trickling filters with Ham Baker distributors (a British type of reversible traveling sprinkler) and was designed to serve a population of 30,000, according to the accepted practice of that period. (See *Engineering News*, 1913, II, p. 1112, and 1916, I, p. 1028.) The northern slope is served by two plants, the larger one consisting of Imhoff tanks and sprinkling filters with nozzles, with the smaller was simply a one-story septic tank.

During the World War considerable trouble was experienced with the distributing machinery in the old Southwest plant, and as the war made it almost impos-

sible to get parts from England, the plant became more or less inefficient. The Imhoff tanks were designed on a basis of ¾ cu.ft. per capita and under present-day ratings are sufficient to care for only 12,500 people. As Springfield has been having a very steady growth, with a present population of about 60,000, this plant was soon operating at over capacity and contamination in Wilson Creek caused more and more complaints. These complaints finally led to suits for damages by the farmers living on the creek into which the sewage emptied. After a careful study of the situation it was decided that the old plant could be used to its capacity and a new plant constructed about half a mile farther downstream to serve 47,500 people, with room for duplicate units as the city grew. The plant just described is the result. It was put into use Oct. 18, 1928, except that one of the filter beds was not completed until a month later. The engineers were Russel & Axon and the contractor was the Stigall Construciton Company.

Bricklaying Research at Mellon Institute

Experimental Walls Built and Studied to Ascertain With Definiteness Many Little-Known Factors of the Art

AN INTERESTING example of collaboration between scientist and artisan is found in the broad scientific study of bricklaying recently begun by the Mellon Institute of Industrial Research and the Eastern Face Brick Manufacturers' Association. The experiments are being carried out by Dr. F. O. Anderegg, senior industrial fellow of the institute's multiple industrial fellowship on portland cement, and his assistants; architects, building contractors and masons are aiding the work by contributing opinions and advice.

So many varying factors are involved in the construction of a brick wall that it has been necessary to limit the experimental study to combinations of variables representing the probable range of practical application. Hundreds of thousands of experiments would be required if all possible combinations were to be studied. For this reason the research program has been under discussion for some time, and the actual investigation was begun only when a satisfactory plan had been formed. Up to now some 300 experimental walls or panels have been erected on the grounds of the Mellon Institute; a supplementary series will be constructed next winter.

In brief, the investigation will cover certain aspects of all the factors involved in bricklaying. The most obvious points of attack are studies of the characteristics of different kinds of brick and mortar. Problems of special appeal to the practical man are those concerned with different methods of backing and with differences in workmanship. The design of walls and their relative elasticity are subjects which will be of considerable interest to contractors and architects.

Brick and mortar problems under investigation include the absorption and surface characteristics of brick, and differences in mortars due to varying the cementing materials, sand and pigments. Properties of the mortars which are being studied carefully are workability, compressive and transverse strength, absorption and permeability, shrinkage, durability, staining and efflorescence and elasticity. Information is being collected to determine whether the 10 per cent of lime often specified by architects or the 25 per cent or more usually employed by brick masons gives better all-around results.

The problems in backing include a study of hollow tile of different sizes, of brick, of cinder or concrete block, of brick tile and of metal or other lath on steel frame. Variations in workmanship are most apparent in regard to tapping, pointing and the filling of head-joints.

Among the most important problems of design are the nature of the backing unit and the method of connecting the face and backing. Coping and parapet construction are likewise being investigated. Capillary contact with the ground and condensation allow moisture to penetrate into the wall and must be guarded against. Finally, a study of special interest in this day of high buildings is the elasticity of walls of different types.

Special mention should be made of weather problems. The experiments have been planned for the purpose of investigating the behavior of mortar with reference to the other variables in all types of climatic conditions.

Stresses in Curved Beams Studied by Plaster-Model Tests

A new application of the method of studying stress distribution in members of complex form by rupture tests on plaster of paris models is reported by Prof. F. B. Seely and R. V. James in Bulletin 195 of the University of Illinois Engineering Experiment Station. The method, which has had several prior applications in experimental stress investigations during recent years, depends on the fact that set plaster is almost perfectly brittle, having a straight-line load-deformation curve up to rupture; therefore relative values of rupture load in two plaster members will represent the relative stresses which similar members of ordinary ductile materials would experience within their elastic limits. Bulletin 195 reports tests on a considerable number of U-shaped beams (hooks) of various cross-sections and various degrees of sharpness of curvature. Individual results, checked against simple bending tests on the straight ends of the broken hooks, showed large variations, but averages of five to ten specimens gave curved-beam coefficients agreeing fairly well with those derived from the Winkler-Bach formula. The same test method was then applied to measuring the radial tension in hooks of H-shaped cross-section; radial tension breaks were obtained in all specimens except those amply filleted, and the measured values of radial tension checked approximately the values computed from theory.

Railway Improvement Expenses

Improvement works carried out by the railways during 1928 for increased safety and facility of operation aggregated approximately $195,000,000, according to a statement issued by the Bureau of Railway Economics. The main items listed are as follows: heavier rails, $56,990,037; steel passenger cars, $32,377,329; protecting and eliminating grade crossings, $30,809,416; freight yard extensions and improvements, $19,489,958; additional main track, $17,306,808; permanent steel and concrete bridges replacing timber structures, $10,764,955; automatic block signals, $10,528,102; passing tracks, $6,461,896; interlocking plants, $5,501,010; automatic train control and cab signal devices, $3,020,653.

FIG. 1—ERECTING A 1,575-FT. CONTINUOUS TRUSS RAILROAD CROSSING OVER THE OHIO RIVER AT CINCINNATI. Sidespans erected on falsework. Old railroad bridge upstream to be converted to a highway toll structure upon completion of new crossing. Note widened channel (675 ft. c. to c. to piers) provided by new bridge.

Continuous Truss Bridge 1,575 Ft. Long at Cincinnati

Ohio River Structure Part of $12,000,000 Improvement Program of C. & O. Railway—Replaces Old Structure, Which Will Be a Toll Highway Crossing—Erection by Locomotive Cranes

ONE of the heaviest and longest continuous truss bridges in existence has recently been completed by the Chesapeake & Ohio Railway in connection with its improvement program in Covington, Ky., and Cincinnati, Ohio. The structure, a double-track E-70 silicon steel continuous truss bridge 1,575 ft. long center to center of end bearings with a center span of 675 ft. and two side spans of 450 ft. each, is to replace an old two-track E-40 bridge of three simple spans directly upstream. In fact, the river pier of the old bridge on the Kentucky side, has been extended to carry the south end of the new 675-ft. center span. The north end of the new center span could not be carried in a similar manner, because the War Department demanded a minimum span center to center of piers of 675 ft., whereas the distance between the channel piers on the old bridge is only 550 ft. The old bridge, in addition to carrying two railroad tracks, carried a highway deck cantilevered out on each side. The downstream cantilever deck interfered with the erection of the new bridge, so it was removed and all highway traffic was handled on the upstream roadway with the aid of block signals. With the completion of the new railway bridge, the tracks on the old bridge will be removed and replaced with a floor, thus revamping the structure for use as a highway toll bridge.

The old bridge was built in 1886-88 by the Covington & Cincinnati Elevated Railroad & Transfer & Bridge Company, a subsidiary of the Chesapeake & Ohio Railway. Entirely adequate for all expected traffic at that time, the bridge proved to be a bottleneck for the heavy traffic passing between Cincinnati and Covington in recent years. It was used daily by 34 passenger trains of the Chesapeake & Ohio and the Louisville & Nashville, all of which moved across the bridge twice, because both roads maintain engine terminals and coach yards on the Kentucky side. It was also used by other passenger trains and by many transfer trains handling freight.

Four elevated lines of railway track connect to the new bridge at either end. On the Kentucky side of the river, 1,600 ft. of old viaduct approach has been replaced by a new double-track plate-girder viaduct. This work is part of a grade-separation plan in Covington. The separation through the business part of the city has been accomplished by placing the railway approach to the bridge on a 0.3 per cent grade extending from the river to replace the 1 per cent grade of the old approach, thus permitting a majority of the streets to underpass the railway. Two streets have been closed to traffic and three of the streets farthest from the river are carried over the tracks. The Ohio approach has three arms embracing a total of about 6,200 ft. of steel viaduct and a considerable length of wood trestle. One of these branches goes to the Fourth St. station of the C. & O., another extends westward to a connection with the tracks of the Big Four and affords a means of access to the Central Union station, and the third connects with the Chesapeake & Ohio of Indiana.

This article will consider briefly the somewhat difficult foundation work, the design methods used on the statically indeterminate trusses and the methods of erection used, which were interesting and unusual largely because of the simplicity with which the entire work was handled by locomotive cranes without any interruption to traffic on the old bridge.

Foundation Work—The foundation work involved the construction of piers on both the Ohio and the Kentucky shores, the construction of a new pier 125 ft. shoreward of the old bridge pier on the Ohio side of the main channel and the extension of the old bridge pier on the Kentucky side of the channel a distance sufficient to carry the shoes of the new bridge. The latter work was rendered more difficult because the track level

on the new bridge is approximately 3 ft. higher than on the old structure, a requirement made necessary to avoid a reduction in the established waterway headroom as a consequence of the use of a deeper floor system on the new structure.

For the river piers the caissons were sunk by open dredging and were covered over and subjected to air pressure only in order to clean out the working chambers and permit inspection of the foundation beds. Foundations were on shale and limestone overlain with 40 to 50 ft. of silt sand and gravel. The shore piers are monoliths of concrete, the north pier being of unusual design and size. It consists of a transverse wall about 60 ft. high and 12 ft. wide, braced by two counterforts under the truss bearings, having a length parallel to the bridge center line of 45 ft. 4 in. and a width of 15 ft. It is supported on 400 concrete piles in a footing 61 ft. square designed to resist the longitudinal wind and tractive forces on the 1,575-ft. span whose shoes are fixed at this end. Reinforced-concrete sheetpiles 8 in. thick and 25 ft. long placed on the north and south faces of the footing of this pier provide additional resistance.

The task involved in widening the south pier of the old bridge to carry the new bridge seat was the most interesting and difficult foundation work. The old pier was 79 ft. wide at the base, supporting on a shallow concrete block a rock-filled timber crib 35 ft. high, from the top of which the stone masonry pier rose some 100 ft. to the old bridge seat. The extension of the pier was accomplished by sinking a caisson 40 ft. wide and 50 ft. deep beside the old pier considering it as a separate foundation, clearing the rough face of the old pier by about 10 ft. Above the top of the caisson the extension is joined to the old pier. The width of the extension is such that it lines up with a reinforced-concrete jacket 2 ft. thick placed around the old pier. In addition to dowels, this jacket includes steel channels set vertically above the belt course and held in place by tie-bolts passing through the old pier. The pier as completed is 121 ft. wide at its base and carries the old bridge with trusses 30 ft. center to center and the new bridge with trusses 34 ft. center to center, providing a clearance between the center trusses of 10 ft. 4 in.

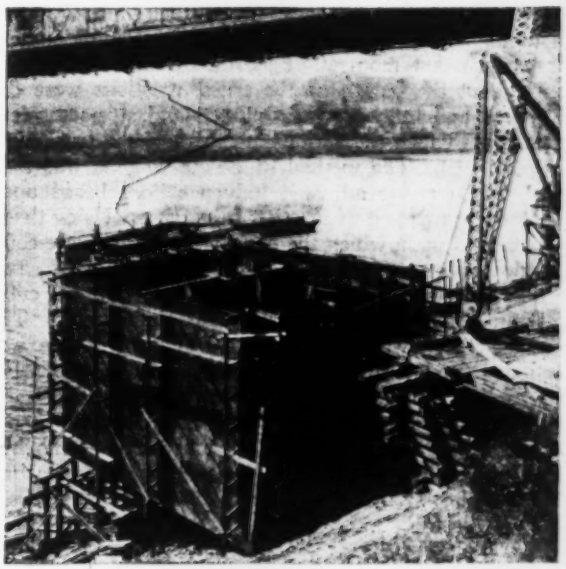


FIG. 3—CAISSON FOR SOUTH RIVER PIER BEFORE LAUNCHING

Note concreting work for north river pier in background. concrete brought out on track on old bridge in cars and spouted to place.

The weight of the upstream side of the new bridge is divided between the old pier and the extension.

The concreting plant was placed on shore and was provided with an elevating tower of sufficient height to deliver the concrete to narrow-gage cars operating on a track carried on the roadway, which was bracketed to the west side of the old bridge. A gasoline locomotive hauled these cars across the bridge to the particular pier under construction, where the concrete was dumped into spouts as shown by Fig. 3.

Design—The bridge is one of the longest and heaviest continuous trusses in existence. Resting on four supports, it is fixed at the north or Ohio end and fitted with expansion shoes at both the river piers and at the Kentucky end. The continuous design permitted a saving in steel over a series of simple trusses, according to the designers. The use of silicon steel afforded a further decrease in weight with attendant economy which was advantageous particularly from an erection standpoint.

In the preliminary plan the chords were made closely parallel, the top chords sloping slightly. However, consideration of economy and appearance led to the adoption of a truss of considerably greater depth over the channel piers than in the outer ends of the side spans and the middle portion of the center span. This resulted in a truss with top chords not parallel to the bottom chord except in the middle part of the center span. The analysis of stresses in such a truss is considerably

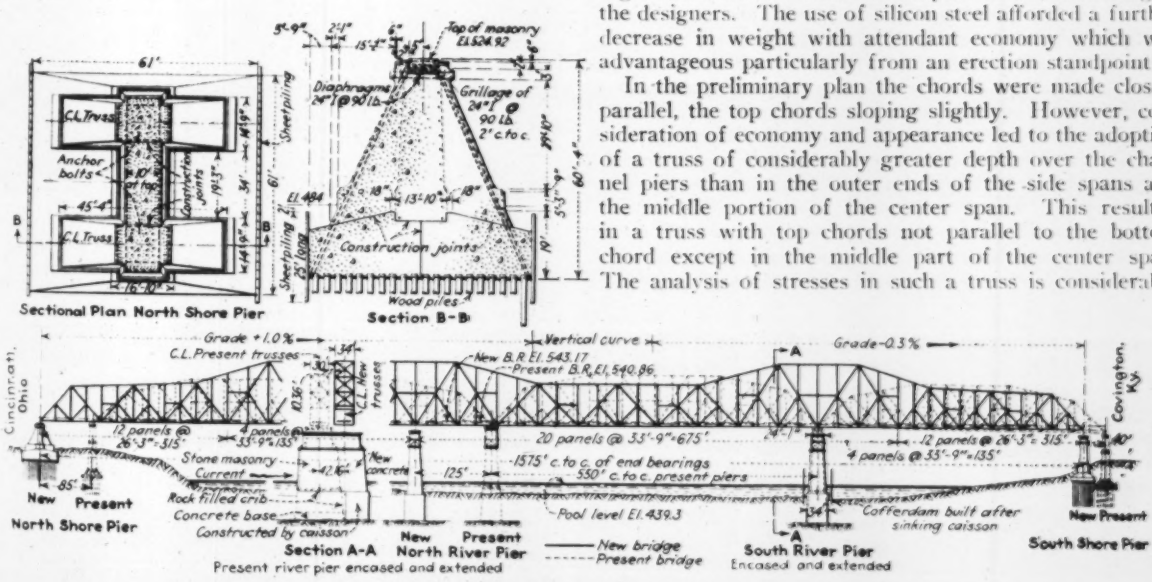


FIG. 2—ELEVATION OF 1,575-FT. CONTINUOUS TRUSS AND FOUNDATION DETAILS

more complex than in one with parallel chords. After assuming a weight of the finished structure and assuming first a constant moment of inertia of the truss section throughout the length of the truss, reactions were determined and influence lines plotted and stresses calculated from which the various members of the truss were proportioned. The method of elastic weights was then used to determine adjusted influence lines based upon the varying moment of inertia of the truss. Using these, the stresses upon which the design was based were computed.

The dead load was figured for steel at 490 lb. per cubic foot and track at 700 lb. per foot of single track. The live load used was Cooper's E-70 and the bridge was designed for lateral forces on the loaded chord of 1,100 lb. per linear foot plus 10 per cent of the specified trainload on one track and 400 lb. per linear foot on the unloaded chord, these forces being considered as moving. The longitudinal forces to be resisted from the starting and stopping of trains were calculated with a coefficient of friction on the engine drivers of 20 per cent and on the remainder of the train of 10 per cent.

Provision was made in the design for the erection of the two side spans on falsework supported on piles driven in the river bottom, with the halves of the center span erected as cantilevers. Large secondary stresses over the piers were relieved by giving extra section to the lower chord and the adjacent end posts. Also, the first hanger on either side of the pier was made $\frac{3}{8}$ in. short, and the lower chord jacked to a connection therewith so as to introduce a temporary secondary stress of opposite sign to that expected in the completed bridge, which was therefore relieved when the trusses were fully loaded.

An interesting feature of the fabrication was that the fabricator, because of crowded shop conditions, did not lay out the trusses in the yard, as is customary, but figured the length of the steel to produce the desired camber. With the lengths figured, the holes were reamed out with the aid of a steel templet.

The bridge is anchored to the north pier and an expansion joint of unusual design is provided at the south end of the structure, this joint permitting a longitudinal movement of 24 in. in the structure without disturbing the track. The detail of this expansion joint is shown in Fig. 4. In this same illustration are shown details of the fixed shoe of the north abutment and of the rocker shoe on one of the center piers. The other rockers used are similar, except that the one at the south end allows for a maximum movement in either direction of 11 in., or a total movement of 22 in.

Erection—In many respects the erection work on this important structure was its most interesting feature. It is believed to be the heaviest bridge yet erected by locomotive cranes. The elimination of the special traveler, which in addition to being expensive is unusually heavy and cumbersome, is said to have effected considerable saving in the erection cost.

As previously stated, the 450-ft. side spans were erected on an elaborate system of wooden falsework resting on wood piles in the river, while the center span was cantilevered from both ends to the center. The falsework is shown in place in Fig. 1. It was approximately 100 ft. high above pool elevation of the river. Its supporting piles were driven with a hammer and leads hung from a crane boom on the falsework deck. Piledriving was assisted by a barge in the river anchored so that one of its sides lined up with the falsework bent to be driven. The leads were lowered by the crane and clamped to this side of the barge. A double-acting steam hammer was used.

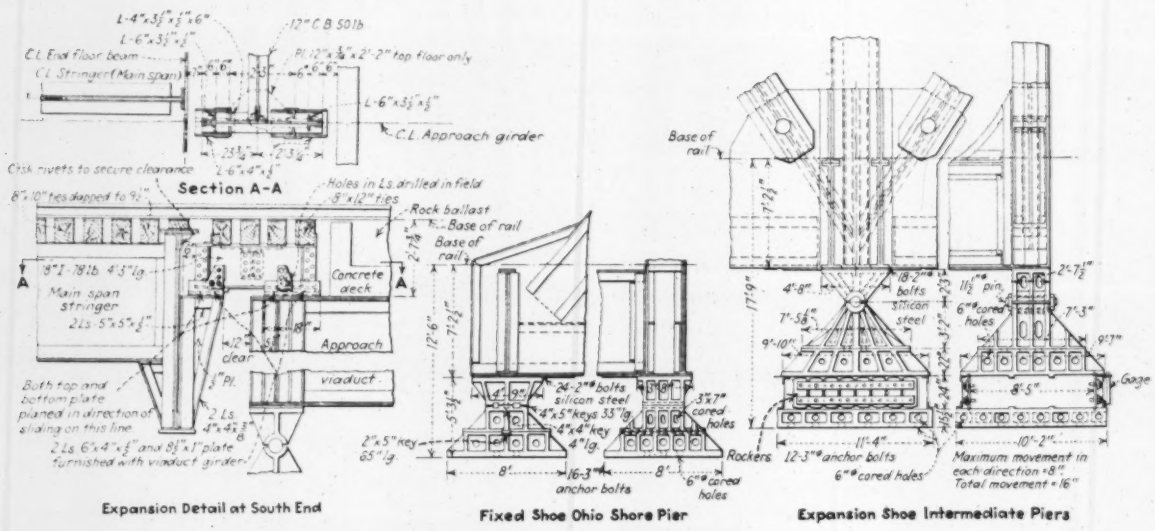


FIG. 4—SHOES AND EXPANSION DETAILS

The approach viaducts were completed before erection of the main span was begun and thus gave access to both ends of the bridge for the 60-ton standard-gage locomotive cranes which erected the falsework and the steel superstructure. The Kentucky shore span was set longitudinally $6\frac{7}{8}$ in. north of its final position—that is, toward the river—to facilitate joining at the center of the bridge later.

The floor system of these side spans was erected on the falsework, steel being brought out from shore. With the floor system in place, the cranes picked the truss steel directly from barges in the river and set it in the bridge. At the completion of the side spans they were swung off the falsework and it was removed.

In erecting the center span by the cantilever method, working from both ends toward the middle, the heaviest and longest pieces occurred over the piers. Here the

trusses were 105 ft. deep and the locomotive cranes were rigged with 145 ft. booms (Fig. 5). Where the trusses became shallower, the length of the boom was reduced, first to 120 ft. and later to 95 ft. Some time was lost in changing the booms, but it was necessary and not considered a material disadvantage. The greatest difficulty with the locomotive cranes was caused by troublesome high winds. However, special precautions were taken to anchor the cranes to their tracks and no accidents occurred.

In its final position the bridge is fixed on the Ohio shore pier and is free to move on the rockers at the

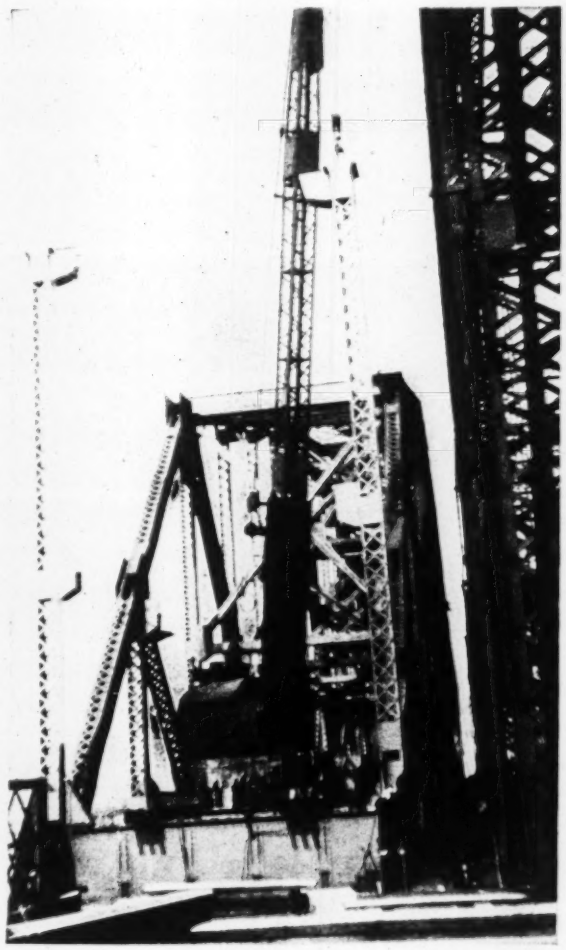


FIG. 5—LOCOMOTIVE CRANE SETTING HEAVY STEEL ON C.&O. RAILWAY BRIDGE AT CINCINNATI

three other piers. During erection, however, it was fixed by temporary lock bars at piers 2 and 3 (the river piers) and free to move at both land piers.

At the middle of the center span the bottom chord members were first joined by a 9-in. pin in a slotted hole 15 in. long in the direction of the axis of the bridge. The ends of the shore spans at piers 1 and 4 were supported on jacks. As these were lowered, the effect was to raise the cantilever arms at the center of the 675-ft. span, thus providing end clearance for the closing top chord members. With these closing members in place, the ends of the shore span were raised until the top chords came to a bearing. The top chord splices were then bolted and the temporary lock bars removed from the expansion rockers on pier 3. This permitted the south half of the bridge to be moved longitudinally on piers 3 and 4. Jacking at the ends of the shore span was then resumed, and the raising of these ends resulted in pushing the south half of the bridge toward the shore until the 9-in. pins in the bottom chords reached the ends of the slotted holes. In this position the bottom chords began to take tension while the top chords began to take compression. The bottom chord splices were then bolted and jacking was continued until the shore ends were approximately at their final elevation. Then the shoes at pier 1 were fixed and the rockers at pier 2 were unlocked.

After the tracks were laid on the bridge in permanent form and the dead load was all in place, the bearings at the center piers were adjusted to proper elevation by jacking to bring the reaction at each of the shoes to the desired amount; shims were inserted at the shoes to hold the ends of the bridge at this correct elevation.

The Cincinnati-Covington bridge and the grade-separation work was handled under the direction of C. W. Johns, chief engineer of the Chesapeake & Ohio Railway, Richmond, Va., with G. G. Lancaster, assistant engineer at Covington, Ky., in charge. The erection of the superstructure was under the general direction of Richard Khuen, Jr., general manager of erection, and in direct charge of James L. deVou, central district erecting manager of the American Bridge Company. The J. E. Greiner Company, consulting engineers, Baltimore, Md., designed the bridge.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Traffic Accidents—Correction

Sir—Permit me to call your attention to an error in your Oct. 10, 1929, issue, in which you quote from my paper on traffic accidents, stating that "traffic-light intersections are 50 per cent more hazardous after signalization," whereas the paper stated that "light traffic" intersections were more hazardous following signalization, meaning by the words "light traffic," intersections having traffic below an average of 800 vehicles per hour.

As it is set up in *Engineering News-Record*, the statement is a direct contradiction of the statement just preceding it.

HAWLEY S. SIMPSON,
Traffic Engineer,
County of Essex, New Jersey.

Newark, N. J.,
Oct. 15, 1929.

Meetings and Papers of the American Society of Civil Engineers

Sir—There are two items referring to the American Society of Civil Engineers in your issue of Oct. 17 which will bear considerable emphasis. The first is your editorial about "Specialization" and, by the by, there's a booklet by Chic Sale about that. Really, however, I feel that for myself I have received incalculable benefit from the papers read in the old days at the meetings of the society in New York about those branches of the profession about which I knew very little. Items of information garnered at these meetings have been extremely valuable to me in connection with my own specialty, and I believe that the conventions would be more valuable if all those attending were brought together at one meeting place to hear the papers to be presented. That paper at Boston on the Lake Champlain bridge should have been interesting to every engineer, and

incidentally one paper like that with discussion is enough for one sitting.

To Charles Rufus Harte, whose letter appears on p. 628, I extend a hearty handshake. I don't know about the Procrustean bed, but to express my sentiments very mildly I have felt much worse than even he seems to have about that policy of editing (God save the mark!) the society papers and discussions. I have expressed my sentiments about this to presidents, secretaries and directors without avail. As he says, no one would object to certain editing to conform to reasonable regulations, but the assumption of omnipotence in grammatical form and expression by some one on the editorial staff is not only ridiculous but absolutely devitalizing to the papers and discussions. F. Lavis.

New York, N. Y., Oct. 21, 1929. President, International Railways of Central America.

Spiral Flow in Sewage Treatment

Sir—In your article in *Engineering News-Record* of Oct. 17, p. 623, referring to the operation of the Indianapolis sewage treatment works, I note particularly what you say in reference to the original use and arrangement of fine screens in connection with primary settling and also your reference to spiral flow in activated-sludge treatment. Without wishing to take undue credit, I believe that spiral flow as developed in Indianapolis has the distinction of not only being first in America but the idea and results obtained are very different from those which are possible by the use of the Manchester system. That is to say, without the use of deflecting baffles there is no particular economy in construction, nor as far as I know is there any special advantage in operation over the ridge-and-furrow system developed at Milwaukee.

The American system of spiral flow, which was first used at Indianapolis and which design has been followed in nearly all of the principal plants constructed since the Indianapolis plant was completed, permits the use of comparatively wide tanks. The Indianapolis tanks are 20 ft. wide and 15 ft. deep. In the Indianapolis demonstration plant, tanks were used with channel widths of 30 ft., and a recent design has tanks 10 ft. deep, with a channel width of 40 ft. You will readily understand that with the Manchester system the principal velocity is up and down and therefore the air must be admitted comparatively close to one wall to prevent reversal or counter-currents, and without baffles the extensive width of tanks is not possible. The wider and perhaps shallower tank gives more surface aeration as well as more exposure to the rays of sunlight, which is important, and gives a more economical use of the air for agitation in addition to what may be needed for bio-oxidation.

I am under the impression that engineers generally do not appreciate the difference between the American spiral-flow system and the Manchester system. After reading the article it seemed well to call this to your attention. The illustration herewith shows the 30-ft. sectional width of tank in operation at the Indianapolis experimental plant, and illustrates more clearly the statements made in this letter.

Charles H. Hurd, Consulting Engineer.

Indianapolis, Ind., Oct. 23, 1929.

Acknowledging Applications for Positions

Sir—I have read with a great deal of interest the letter signed "Engineer," which appeared in your issue of Sept. 26, 1929, p. 508, and I want to go on record at this time in telling you that I heartily agree with the writer of that letter.

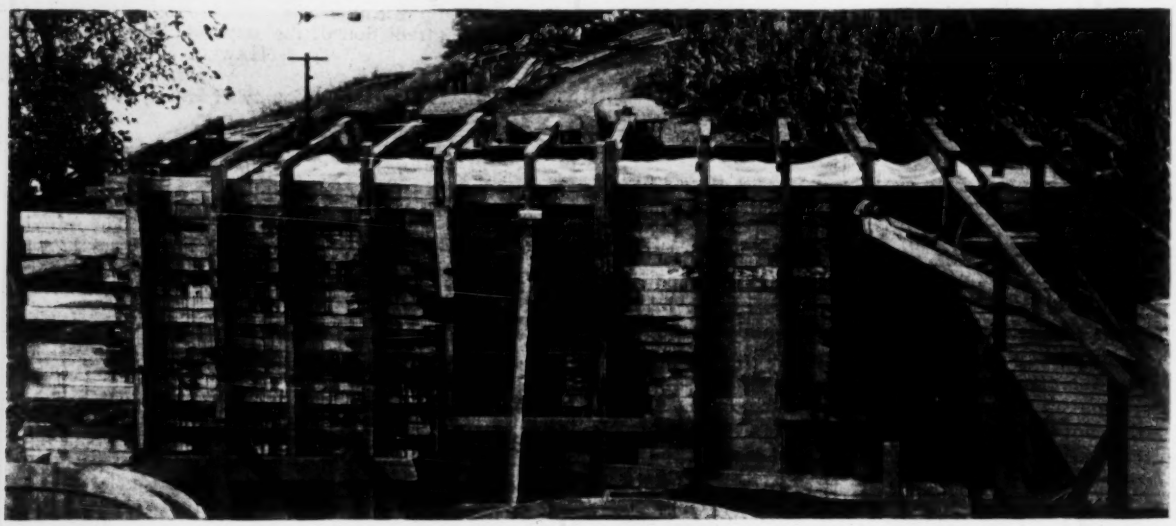
During the past year I have answered a number of these advertisements and have accompanied my application with a complete record covering my professional experience, education, etc., together with photographs and other data. Many times I have sent self-addressed stamped envelopes and asked for a return of my papers, but in only one case have they been returned. These records cost considerable to prepare both in time and in money and are of no use to anyone except the applicant, so I can see no reason why the advertiser should not be willing to return them, especially when the cost to him is but a few cents.

I sincerely believe that *Engineering News-Record* should insist on a prompt answer to all replies to its advertisements for positions vacant. It costs but little to drop a line to the applicant telling him that the position is filled or that he is not fitted for the position and it allows him a chance to seek employment elsewhere. It seems to me that the duty of any magazine is just as great to its subscribers as it is to its advertisers, perhaps greater, and simple courtesy should be insisted upon. Another Engineer.

Memphis, Tenn., Oct. 3, 1929.

As each group of applications is forwarded to an advertiser of a position vacant a memo is attached which reads as follows:

"These answers are submitted by each of the applicants with the hope of securing the position advertised. If they receive no acknowledgment from you, these men will wonder if their letters have been delivered. To help them and us, will you kindly return the letters of unsuccessful applicants marked, say, 'Position filled, thank you.' If you don't care to reveal your identity, mail them in plain envelopes. We suggest this in a spirit of helpful co-operation between employers and the men replying to 'positions vacant' advertisements." —Editor.



SPIRAL-FLOW SEWAGE TANK AT INDIANAPOLIS

News of the Week

Large Earth Dam Planned in Wyoming

The largest earth dam in Wyoming, except the reclamation service's Gurnsey dam across the North Platte River, is to be completed 35 miles northwest of Cheyenne on North Crow Creek in time to conserve spring floodwaters in 1930. The dam is to be 86 ft. high, 486 ft. thick at the base and 608 ft. long at the crest. Designed by Reclamation Service engineers to impound waters of North Crow in a 1,300-million-gallon basin, the project is to cost approximately $250,000 and should supply the needs of Cheyenne for at least fifteen years.

Los Angeles to Have New Pumping Station

The city of Los Angeles, Calif., has made plans for the erection of a new pumping station for transferring water from the reservoir outside the city into the city mains. The new plant will be known as the North Hollywood station and will be capable of moving approximately 64,800,000 gal. daily against a head of 225 ft. with four pumping units. Each of the two main units consists of a two-stage pump, composed of two 24-in. horizontal units in series, these being flexibly coupled together and in turn flexibly coupled to the driving motor.

Many Countries Represented at Tokyo Congress

World Engineering Congress Begins With Twenty-six Nations Represented—Many Subjects Discussed

McGraw-Hill Cable Report

TWENTY-SIX countries are represented at the World Engineering Congress now being held in Tokyo, Japan. It was opened impressively in the new Municipal Building by Prince Chichibu, with Premier Hamaguchi, Baron Furuichi and representatives of other nations in attendance. On this occasion emphasis was laid by all present upon the marvelous industrial progress of Japan during the short period of 50 years since Perry's visit there, and hope was expressed that the experience gained from other countries would prevent injury to the country's natural beauties and age-old culture in the pursuit of future developments. Speakers from all nations stressed the part played by engineering in the advancement, welfare and economic progress of all countries.

It is impossible to appreciate the thought and labor expended in the planning and execution of details for the Congress. All possible courtesies are being extended, including transportation on government railways to the points of interest. In fact, underlying all addresses was the hope and belief that, while all engineering would be advanced by the Congress, its most valuable result would be the better understanding and appreciation of one another's work and aims—the creation of a brotherhood that could not be shaken by conflict.

Beginning with a suggestion made by Elmer Sperry and approved by President Hoover while Secretary of Commerce, this Congress has grown into the greatest conference yet held for the exchange of engineering education on all phases of modern industry, covering the past and future prospects under most varied conditions. Steam from volcanic heat and electric power generation by windmills are possibilities that have been touched upon. Steam is still favored for locomotives, but the diesel type is increasing, since the turbine type is still experimental, although there is strong rivalry between diesels and turbines powered by powdered fuel. The advantages of high voltage and superpower interchange have been discussed, with the hope for an international steam table and a standard form of power utilization statistics.

The statement was made at one session that automobile transport is growing rapidly in Japan, with battery-driven vehicles being advocated because of low current rates, but few of them are yet in evidence. An interesting paper by Mr. Hirose on the development of mechanization in Japan outlined the change from the importation of all machinery to the present tendency to original design and manufacture. Papers on personnel, management and standardized production, with results obtained, attracted very lively attention and indicated a desire to adopt methods lowering costs of manufacture wherever possible. Papers by Japanese indicate their diversity of manufacturing interests, which include textiles and textile machinery, precision instruments, mining, steam and electric generation, shipbuilding, motor cars, aeronautics, railways, locomotives, building and repair, bridge and other construction.

A dinner given by the American delegates to Japanese engineers was attended by Prince and Princess Chichibu and many notables with their wives, taxing the hotel capacity. Dr. Sperry was toastmaster and addresses were made by Baron Furuichi, Baron Takuma, F. B. Jewett and George Otis Smith.

At a special dinner held by the A.S.M.E. an honorary membership was bestowed on Viscount Shibusawa and the Holley Gold Medal was presented to Baron Shiba. C. E. Grunsky, representing the Am.Soc.C.E., bestowed an honorary membership on Baron Furuichi, president of the World Congress.

THE MOUNT HOPE BRIDGE COMPLETED AND IN SERVICE

©Fairchild Aerial Surveys

By opening on Oct. 24, this structure, with a 1,200-ft. main span and loaded backstays, represents one of the most rapid pieces of construction work on record. It was complete with the exception of the concrete floor about April 1, when broken wires in the cables made it necessary to dismantle the structure and re-erect it with new cables. The work was accomplished in seven months. The bridge is a connecting link in the highway between Providence and Newport, R. I., heretofore served by a ferry.

Denver Upheld in Preference for Colorado Cement

A suit to force the city officials of Denver, Colo., to recognize the bids of the Monolith Portland Midwest Cement Company, of Laramie, Wyo., in civic contracts was dismissed Oct. 26 by Federal Judge J. Foster Symes, who ruled that evidence of discrimination against the company had not been shown. The suit alleged that Mayor Stapleton, City Engineer A. K. Vickery and Manager of Parks and Improvements Charles D. Vail refused to permit the company's cement to be used in municipal work, despite the fact that it measured up to specifications. Judge Symes held that the city had not discriminated against the Monolith product, but merely had chosen Colorado-made goods in preference to those manufactured outside of the state.

California Dam Inspection Act Declared Constitutional

The constitutionality of the California dam inspection act, passed by the 1929 legislature, has been upheld by the Third District Court of Appeals in a decision handed down Oct. 25 in favor of Bent Brothers, Inc., contractors who are building the flood-control dam on the Calaveras River for the city of Stockton.

Bent Brothers had petitioned for a writ of mandate to compel J. P. Campbell, city auditor, to issue a warrant for $70,724 in their favor to cover work done by them under revised plans as ordered by Edward Hyatt, state engineer, under authority of the state dam inspection act. The court ordered the writ issued.

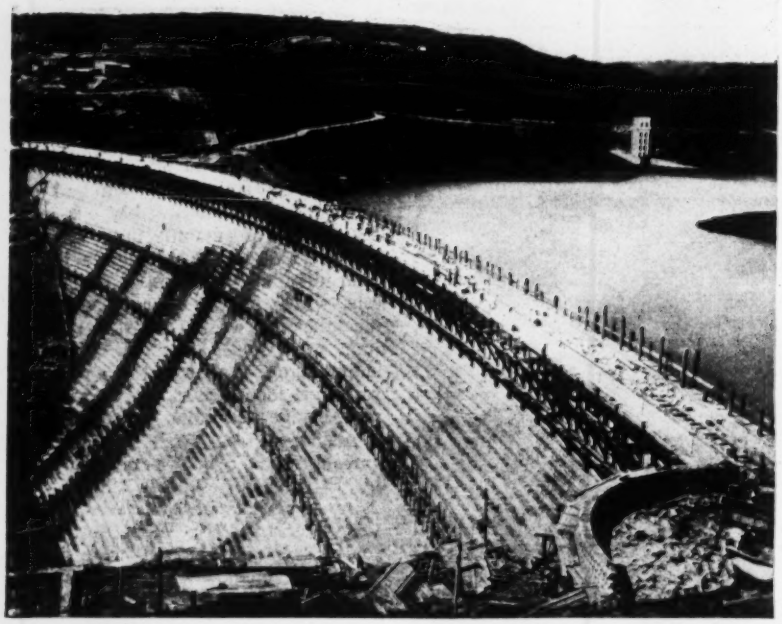
In rendering this decision the appellate court declared that the act is "not only a proper but a necessary exercise of the police power of the state in the interest of protecting life and property." The court pointed out that while the state engineer has not the right to impair the obligations of contractors, "he can maintain suits to prevent the contract being so performed as to create a menace to life and property."

The St. Francis dam disaster in Los Angeles County two years ago was cited by the court as "emphasizing the need of such legislation" as the dam inspection act, which the court declared to be valid in all its essential details.

Indian Funds Not to Be Used for Highway Construction

Indian funds are not to be used for highway construction across reservations unless such action is approved by the Indians themselves, according to Secretary of Interior Wilbur. Furthermore, Secretary Wilbur states, no roads should be built across Indian reservations without the consent of the Indians, except in cases of public interest that would permit condemnation of property for road purposes. The Indian group should be considered as owners of the property with the natural rights of ownership and should be treated accordingly, Secretary Wilbur maintains.

MARATHON DAM, OVERLOOKING IMMORTAL BATTLEFIELD



Marathon dam faced with marble, just completed by Ulen & Company, American engineers, to provide Athens, Greece, with an adequate water supply. The dam is notable for its facing of Pentelikon marble, of which the Parthenon and other classic structures on the Acropolis are built. The water is brought to the Greek capital from the plains of Marathon, through the aqueduct built 2,000 years ago by the Roman Emperor Hadrian. The dam was officially opened with an inaugural ceremony on Oct. 25.

Large Hydro Development Planned in Quebec

The James MacLaren Company, of Buckingham, Quebec, has given notice to the provincial government that it intends to construct a concrete dam and other works across the Lievre River at Cedar Rapids which will create a storage reservoir of 25,000,000,000 cu.ft. of water. The dam will store at all seasons the water at White Fish Lake, Lac des Sables and the Lievre River and its tributaries, with the object of conserving them so as to regulate their flow and thus to assure a uniform supply to the water-works system and to mills, and a constancy of hydraulic power.

Construction of this reservoir forms part of the general development scheme which the company has now undertaken. The works are divided into two principal divisions—water power and pulp and paper. Work is well advanced on the construction of the newsprint mill, which will have a daily capacity of 250 tons. Approximately $6,000,000 will be expended upon this unit. The hydro-electric plant will be located at High Falls and will have an initial installation of three 30,000-hp. units with provision for installation of a fourth later. Construction of the power house will cost about $5,000,000.

Chicago No-Parking Ordinance Held Invalid

A no-parking ordinance for the Chicago downtown business or loop district in effect since Jan. 10, 1928, has been declared invalid by the state Supreme Court in that the city council exceeded a reasonable use of its powers. However, this decision refers to the original ordinance and its wording and not to the amended ordinance under which the present rules are enforced.

Originally the ordinance prohibited vehicles from "standing on any public street," which obviously would not permit pause for accidents, stop signals or even for unloading. The amended ordinance gives a time limit of three minutes for passenger vehicles and 30 minutes for trucks for expeditious loading or unloading, as well as time for accidents and signals. The original difficulty arose from the substitution at the last minute before passage of the word "standing" for "parking" by the Chicago corporation counsel when the original ordinance was passed. This ordinance was then amended with time limits for standing, but the lawsuit was brought in a test case prior to the passage of the amendments in the interest of loop business men, mostly smaller stores, who felt that their trade had fallen off.

Surveys after a year's trial, as reported in *Engineering News-Record* of March 14, p. 438, indicated a decided increase (18.3 per cent) in the number of automobiles entering the district and more rapid movement (15 to 25 per cent) of street cars. Accidents decreased and fewer arrests were made

Tacoma to Acquire Additional Power and Water Rights

Negotiations for the acquisition for the city of Tacoma of additional power projects with an estimated total available capacity of 80,000 hp. have been revealed by Commissioner Ira S. Davisson of the city utilities department in the introduction of an ordinance to appropriate $40,000 for engineering studies of the projects and in a request for approval of an option on certain water rights, dam and reservoir sites and other rights and properties until Dec. 16. The taking of the option was unanimously approved by the city council.

Water rights, dam sites, reservoir sites and other rights and properties on the Duckabush River, the upper and lower Dosewallips and the Hamma Hamma rivers are included in the option taken by the city from Elbert M. Chandler, of Olympia, Wash., and the Hamma Hamma Power & Paper Company. The consideration asked is $370,000, $300,000 to go to the Hamma Hamma Power & Paper Company and $70,000 to Mr. Chandler. The properties lie in Mason and Jefferson counties, which would mean the addition of 30 miles of transmission lines to carry the power to Tacoma.

The largest power development would be on the Hamma Hamma River, for which an appropriation of 350 sec.-ft. of water has been asked. The construction of a dam across this river, 142 ft. high and 875 ft. long at the top, would make available, it is claimed, water storage of 15,800 acre-ft. The water would have a 480 ft. drop to Hoods Canal, according to the figures presented. On the lower Dosewallips, on the upper Dosewallips and on the Duckabush, appropriations of 150, 80 and 50 sec.-ft., respectively, have been asked for power development.

Studies of the power projects will be made under the direction of J. L. Stannard, chief engineer of the public utilities department.

Southwest Water Works Assn. Meets in Tulsa, Okla.

More than 300 water-works men registered at the meeting of the Southwest Water Works Association Oct. 28-30 at Tulsa, Okla. Officers elected for the ensuing year are as follows: president, Max Fife, Blackwell, Okla.; vice-president, W. H. Deaton, Waco, Tex.; district governors, S. P. Bruce, Arkansas; Leonard A. Day, Missouri; Ashbury Endicott, Oklahoma; Charles F. Linck, Kansas; Thomas Amiss, Louisiana; John B. Winder, Texas. Next year's convention will be held in Amarillo, Tex. Thirty-one exhibits were shown, covering meters, cast-iron and concrete pipe, valves for pipe and pumps, pumps, hydrants, chlorine and apparatus, pipe cutters, brass fittings, jointing materials and trenchers.

A well-balanced technical program was presented. One of the papers detailed the results of an exhaustive investigation of electrolysis in New Orleans, by R. J. Kuhn, electrolysis engineer, New Orleans Public Service, Inc. Here electrical resistivity is extremely low, averaging 1,000 ohm-centimeters, facilitating the flow of current. Thorough bonding has produced favorable results. Collection on the water mains of stray currents counteracts the natural galvanic currents and prevents natural soil corrosion.

What the Wall Street Crash Means

It Doesn't Mean—

That the real wealth of the country has diminished one nickel
That there will be any general or serious business depression
That stock prices will go back to the level of six years ago
That common stocks will go out of fashion as investments
That the "new era" illusion is dispelled
That the public is cured of speculation
That the Federal Reserve is to blame

It Does Mean—

That normal business expansion will be somewhat retarded for a while
That business will have to go back to work
That money will be temporarily easier
That there is no such thing as orderly deflation
That banks and investment trusts cannot control the market
That in the end business realities rule stock prices
That the public doesn't and won't believe it

—The Business Week, Nov. 2

Tampa to Vote on $750,000 Airport Bond Issue on Nov. 27

Tampa, Fla., has set Nov. 27 as the date for a referendum on the proposal to issue $750,000 in municipal bonds to finance the building of a modern airport, to accommodate both land and sea planes. The site tentatively proposed is a dredged fill in Hillsboro Bay, an arm of Tampa Bay, with the island so formed to be connected by a causeway with the mainland at Ballast Point. Estimates are based on a 160-acre landing field, 7 ft. above mean low tide, with side slopes of 20 to 1. About 2,800,000 cu.yd. of dredged material would be required for the fill. Open water in all directions and freedom from obstructions would afford the equivalent of several square miles of clear space on land, and the depth of water is sufficient to accommodate seaplanes of any size now projected or in prospect in the future.

Work Resumed on World's Largest Sewage-Disposal Plant

Officially work on the West Side sewage-works of the Sanitary District of Chicago, the world's largest, was resumed Oct. 21, although the contractor had actually been on the job and getting his plant in shape for a month previous. Construction activities came to a standstill in January when funds were cut off due to invalidation of bonds sold for the purpose. Resort was had to the state legislature to permit issuance of sufficient bonds to complete work under way without recourse to a referendum.

The total cost of the West Side project, including a charge of $5,000,000 for additional capacity to care for sludge from the North Side plant and intercepting sewers to collect the sewage, will be $54,600,000, of which the plant will cost $24,300,000. To date $25,000,000 has been expended on plant and sewers. When completed the plant will dispose of the sewage from 1,800,000 people living in the heart of Chicago in three batteries of 36 Imhoff tanks, two batteries of which are under contract. The first will be completed by the end of this year, the second next June and the third will be contracted for early next year.

Three Asphalt Associations Hold Combined Four-Day Conference

More than 500 engineers, contractors, paving technologists, material and equipment representatives, federal, state, county and city officials attended the eighth annual Asphalt Paving Conference made up officially of the Asphalt Association, representing the material and equipment interests, the American Association of Asphalt Paving Technologists (membership 120) and the newly formed contractors' organization, the American Asphalt Paving Association. Low-cost construction formed the compact subject treated in the 40 papers and addresses, highly informing and technical, given before the five sessions.

L. H. Thompson, president of the American Farm Bureau Federation, opened the subject, giving the farmer's side of the secondary road situation. Reapportionment of federal funds away from the primary trunk lines is his aim as well as an increase in the total appropriation. Only 5 per cent of the 6,250,000 farms are served by year-around roads, and much of the farmers' financial plight today he attributes to lack of farm-to-market roads. The Asphalt Association did not go on record favoring definitely appropriating for secondary roads but for more funds in general. Apparently there will be a drive in the coming Congress to allocate federal-aid funds to secondary roads.

Officers elected to head the technologist association are as follows: president, Prevost Hubbard, chemical engineer, Asphalt Association; vice-presidents, Henry L. Howe, city engineer, Rochester, and W. L. Hem-

pelman, the Texas Company, Chicago; secretary-treasurer (re-elected) Charles A. Mullen, Milton Hersey Paving Laboratory, 980 Antoine St., Montreal, Que. This association, which is international in character, having members in Australia and South America, England and Canada, expressed the desire that the conferences be continued another year. The two other organizations do not elect officers at this time. The place of meeting will be decided by the directors at a later date.

A full abstract of the papers and discussions will be given in a later issue.

Hydro-Electric Expansion in Upper Hudson River District

Addition of 86,000 hp. to the hydro-electric development of the upper Hudson River, New York, 52,000 of which will be obtained by enlargement of the Spier Falls plant, is planned by the New York Power & Light Corporation. With the addition, Spier Falls will become a 100,000-hp. station, the largest in the state next to those at Niagara Falls. The new power will bring the total installations of the Mohawk-Hudson system to more than 550,000 hp., as compared with about 775,000 hp. produced at Niagara Falls. The addition to the Spier Falls plant is to be completed for service in December, 1931, and is expected to cost more than $1,000,000.

Still further increases in power expansion in the upper Hudson River district are forecast in recent reports that the Mohawk-Hudson Corporation is negotiating with the Union Bag & Paper Company at Hudson Falls for power rights which involve proposed construction of a new plant at Fennimore to develop 75,000 hp. The first of the new plants for the Mohawk-Hudson system to be placed in operation will be a 34,000-hp. unit situated just below the Conklingville dam on the Sacandaga River.

Sewerage Problems of Washington District to Be Studied

Facilities for the disposal of sewage and drainage water from the Greater Washington district are to be planned by a newly created committee recently organized under the chairmanship of Lieut.-Col. U. S. Grant, Jr., executive officer of the National Capital Park and Planning Commission. A similar committee to deal with the water supply of the same territory has already been organized and will soon present a preliminary report.

The membership of the new committee is as follows: Colonel Grant, Capt. E. N. Chisholm, Jr., engineer, and Charles W. Eliot, 2d, city planner, representing the commission; T. Howard Duckett, Maryland-National Capital Park and Planning Commission; Robert B. Morse, Washington Suburban Sanitary District; Abel Wolman, Maryland State Board of Health; J. B. Gordon, sanitary engineer, District Commissioners; C. L. Kinnier, county engineer, and M. D. E. Laschmutt, sanitary engineer, Arlington County, Va. Representatives are yet to be named by Fairfax County and the city of Alexandria, Va.

State Commission Named to Report on San Gabriel Dam

Edward Hyatt, state engineer of California, has selected the following board to make an investigation into the safety of the San Gabriel dam site under the provisions of the dam supervision law: J. L. Savage, designing engineer, U. S. Bureau of Reclamation, Denver, Colo.; G. A. Elliott, chief engineer, Spring Valley Water Company, San Francisco; M. C. Hinderlider, Colorado state engineer; George D. Louderback, consulting geologist and professor of geology at the University of California; Ira A. Williams, consulting geologist, Portland, Ore.; and Charles P. Berkey, professor of geology at Columbia University, New York City.

All appointees have signified their willingness to serve on the commission.

Nearly 500 Grade Eliminations Proposed for New York State

The elimination of approximately 475 grade crossings at an estimated cost of nearly $70,000,000 is proposed for 1930 by the New York Public Service Commission. These proposed grade separations are in addition to those proposed last year and carried over to this year for further consideration, and are a continuation of the state's extensive program of eliminations carried on for the past several years. Some of the larger projects proposed, with the railroads involved, are: Lawrence, $3,200,000, and Amityville, $1,200,000, Long Island R.R.; Rochester, $3,150,000, New York Central R.R. and Buffalo, Rochester & Pittsburgh R.R.; Batavia, $3,500,000, N. Y. C. R.R.; North Tonawanda, $3,000,000, N. Y. C. R.R., International R.R., and Erie R.R.; Dunkirk, $4,500,000, Nickel Plate, N. Y. C. R.R. and Pennsylvania R.R.; Little Falls, $1,052,000, N. Y. C. R.R.; Herkimer, $1,965,000, N. Y. C. R.R. and New York State R.R.; Whitehall, $1,400,000, Delaware & Hudson Co.; Troy, $6,380,000, Troy Union R.R.

All counties of the state except four are involved in next year's program. Hearings will be held in Albany Nov. 7 and 8 at which the railroads, counties and municipalities interested will be asked whether they expect to borrow from the state to pay for their respective shares of the cost of the work or if they will pay from their own funds.

Fatal Hoisting Accident in Chicago

In hoisting a 2-ton load of facing stone for an office building at Madison and La Salle Sts., Chicago, on Nov. 1, the platform tipped when at the 34th floor level, allowing the stones to fall, striking projections which caused them to fly out into the street, killing one man on the opposite sidewalk, slightly injuring two or three persons, breaking windows and causing other incidental damage. The load was being hoisted by a derrick at the 45th floor, governed by signals, and was to be landed at the 34th floor, but according to report there was some misunderstanding and no men were at this position to guide the load as it was swung in against the building. Whether it was guided from below by a tag line is not certain. The coroner will hold an investigation as to the cause of the accident.

New Union Depot Proposed for East St. Louis, Ill.

Negotiations for the construction of a new union railroad depot in East St. Louis, Ill., to cost $600,000, and the rerouting of all passenger trains into St. Louis from the east, are being conducted by officials of the Terminal Railroad Association of St. Louis and the East St. Louis city commissioners. A draft of a proposed ordinance providing for vacating certain streets and granting needed rights-of-way for the improvements has been submitted to the East St. Louis city council. Railroad approaches to the new station and to the eastern end of the Municipal bridge would bring the total cost of the project to $4,000,000.

Complaint Dismissed in Boston Station Case

The Interstate Commerce Commission has dismissed a complaint brought in March, 1928, by Edmund D. Codman, alleging that the contract between the Boston & Maine Railroad and Dwight P. Robinson & Company for construction of the road's new North Station in Boston violated section 10 of the Clayton act because Homer Loring, a director of the B. & M., was a stockholder in the construction company. The facts developed by the commission are that one week prior to June 16, 1926, when the contract was ratified, all the stock owned by Mr. Loring and the members of his family and by Loring & Company was sold to the construction company and cancelled. Mr. Loring testified that the stock was sold at a sacrifice to enable the railroad lawfully to enter into an advantageous contract with Dwight P. Robinson & Company. The commission finds that divestment of the stock was bona fide, that no profit accrued to Mr. Loring from his previous association with the construction company and that there is no reason to believe that the law was violated.

PITTSBURGH BRIDGE WINS DESIGN AWARD

The Sixth St. bridge over the Allegheny River at Pittsburgh, Pa., has been awarded the Institute of Steel Construction's award as the most beautiful bridge built in 1928. The bridge was designed by the bureau of bridges, Department of Public Works, of Allegheny County. Norman F. Brown is director of the department, V. R. Covell is chief engineer and Stanley L. Roush is the county architect. It was built by the American Bridge Company and the Foundation Company. The personnel of the award jury was George H. Pegram, William A. Delano, Ralph T. Walker, Charles Evan Fowler and H. Horace McFarland. A bronze tablet recording the award is to be placed upon the bridge by the Institute of Steel Construction.

New Rapid-Transit Plan Proposed for Chicago

A new step in the protracted controversies and negotiations over Chicago's rapid-transit problem is the presentation of a plan by a board of engineers for a ten-year program of construction and improvement involving expenditures aggregating $285,610,000. For the city, the cost would be about $85,610,000 for the construction of subway lines. For the companies, the $200,000,000 includes $62,952,000 for extensions of the elevated lines, $28,243,000 for additional tracks on the present elevated lines, $17,675,000 for extensions of the surface electric lines, $31,740,000 for improvements to these lines, $54,050,000 for cars and equipment and $5,340,000 for equipping and operating the city-built subways. This plan, providing for a population of 6,000,000 by 1950, has been submitted to the local transportation committee of the city council by George M. Wisner, R. F. Kelker, David A. Wallace and Edward J. Noonan. If the project is approved by the committee, after consideration, it will be submitted to the city council. At the same time the financial interests have developed a plan for complete unification of all local rapid-transit facilities and the organization of a controlling company with a capital of about $500,000,000. At present many of the franchises have expired and the companies are operating under temporary permits.

In this and all previous projects of the kind the plan has been for shallow-depth subways in the Chicago clay, but the city council has now directed the board of engineers to submit plans and estimates for deep-level subways in solid rock. It is thought that the higher cost of excavation may be more than offset by the saving in cost of moving the network of sewers, water mains and electric conduits under the streets and of reinforcing building foundations in the clay stratum.

A.S.M.E. to Celebrate 50th Anniversary of Founding

The 50th anniversary of the founding of the American Society of Mechanical Engineers will be celebrated April 5-9, 1930, in assemblages to take place successively in New York, at Stevens Institute in Hoboken, N. J., and in Washington. The exercises will be non-technical in nature and will stress the humanistic side of engineering. They will be pre-eminently an exchange of greetings between nations through the medium of a series of papers presented by a prominent engineer from each of sixteen countries or geographical divisions of the world. These papers will develop the theme of what engineering has done for each author's country in a national sense and also for the advancement of world culture and civilization. They will also endeavor to forecast the lines along which engineering may be expected to develop in the future, and to inform the convocation of some of the great engineering problems confronting their respective nations.

Twenty-five Cities to Have Schools in Street Paving

Twenty-five cities have already been registered for schools in the design and construction of concrete street pavement for 1930, according to the Portland Cement Association, under whose direction the courses are held. Figures compiled by the association show that nearly 5,000 men interested in road-building problems took the courses offered during 1928 and 1929.

To Discuss World Power Problems at Berlin Next Year

Representatives of 47 countries, including engineers, statesmen, economists and others interested in power problems, are co-operating in arrangements now being made for the second plenary meeting of the World Power Conference to be held in Berlin, Germany, June 16-25, 1930. The object of the conference is to exchange information on the general subject of power, this being divided into four broad divisions: engineering, covering the minimum waste of power, the most reliable methods for its utilization and the broadest fields of application; economics, including the opening of new markets and the improvement of such markets so as to provide a profitable field for investment; administration, with which is connected legislation, the protection of health and the more extended use of power; and education.

National committees and representatives have been appointed in each of the countries which are to participate, the chairman of the American committee, which has recently been placed upon a permanent basis, being O. C. Merrill, Washington, D. C.

In order to indicate the scope of the conference and to assist participants, a series of suggestions based upon the principal objects of the meeting have been worked out by a committee of 300 German experts. These suggestions are divided into groups as follows: (*a*) solid fuels; (*b*) liquid fuels; (*c*) gaseous fuels; (*d*) steam power; (*e*) internal combustion engines; (*f*) water power; (*g*) mechanical transmission of power; (*h*) electricity; (*j*) power and legislation; (*k*) standardization; (*l*) education; (*m*) statistics. Papers submitted to the conference will not be read at the meeting, but will be printed and distributed to all participants beforehand. Discussion will follow the reading of general reports which will give a clear picture of the contributions received in each particular section and the outstanding points to be discussed.

Papers must be submitted through the national committees, and, where possible, should be sponsored by an organization recognized as authoritative.

Elaborate preparations are being made for the entertainment of those attending the conference, including visits to German industrial centers.

The main subject about which the discussion will center at the 1930 conference is the development of power supply and power utilization. It is hoped to center the collective knowledge and experience of the whole world in such directions as: new fields for the application of power; efficient utilization of generating plants and distribution network and the improvement of load factors; storage of power; interconnection of different producing plants; construction of central plants and power-distributing systems; reduction in cost of construction; tariff systems; cooperation among power producers, consumers, public authorities and the legislature; safety measures; and information and education.

South African Bridge Opened

A combined railway and highway bridge of fourteen steel spans with a total length of 1,560 ft. and a width of 32 ft. has been completed across the Limpopo River between the Transvaal and Southern Rhodesia in South Africa at a cost of $625,000. The structure was designed by Ralph Freeman, of Sir Douglas Fox & Partners, in collaboration with Sir John Burnet & Partners as architects, and was built by Dorman, Long & Company, Ltd., contractor. It is an important link in the railway expansion planned by the late Cecil Rhodes and was built with funds bequeathed by Alfred Beit, who left $12,500,000 to be devoted to railway developments in Rhodesia and adjacent territory. The new structure, to be named the Alfred Beit bridge, will be presented to the governments of the South African Union and Southern Rhodesia.

Chicago World's Fair Plans

Payment of expenditures up to $10,000,000 for the Chicago World's Fair of 1933 has been guaranteed and $5,000,000 is already available as needed, according to statements made at a recent meeting of the financial and architectural committees. It is expected that construction work will be begun in the spring and that certain sections of the exhibition, relating to specific industries, will be opened to the public in 1931 or 1932. A lakefront site has been granted by the South Park Commission. General layout plants and architectural designs are approaching completion. Structural designs for the buildings, several of which are to be of multi-story type, are to be begun soon. Rufus C. Dawes is president of the organization, L. H. Lohr is manager, and engineer and Edward H. Bennett heads the architectural committee.

Brief News

PLANS FOR NEW RAILWAY LINES in western Canada by the Canadian Pacific have been announced. It is stated that within the next five years the company plans new lines involving the construction of about 1,200 miles of track, to cost $50,000,000, and opening new territory for settlement, mineral exploitation and general development.

THE CURTISS AIRPORT near Glencoe, Ill., for the Chicago district was opened with ceremony on Oct. 20. It has an area of about 450 acres, with the commercial and training fields so connected as to permit of a starting runway about ¾-mile long. The entire area is drained and fenced. On the commercial field is a steel and concrete hangar with space for 60 planes and complete repair-shop equipment.

NEW YORK CITY voted Nov. 5 to establish a municipal department of sanitation, placing sewage and garbage disposal and street cleaning throughout the entire city under one responsible head. The work has hitherto been done separately by the individual boroughs.

THE CITY MANAGER PLAN has been established in New Rochelle, N. Y., a city of approximately 48,000 population, by a vote of about 3 to 1.

HIGHWAY SHOULDERS for pedestrians will be established on the newly built roads of Westchester County, N. Y., as the result of approval of the plan by the county board of supervisors.

PIER AND WHARF PROPERTIES of the Canadian National Railway Company in Vancouver, B. C., will be extended to treble the present size at an approximate cost of $750,000, according to an announcement by the company.

DEDICATION CEREMONIES of the new Pittsburgh-Butler airport at Pittsburgh, Pa., were attended by more than 20,000. The field comprises 640 acres and was completed at a cost of $750,000.

BLUFF CITY, TENN., was annexed to the city of Memphis on Nov. 1. The water board has voted $60,000 for extensions into the annex, and a bond issue of $850,000 for sewers, mostly for the new addition, has been approved by the city commission and a public election.

DEVELOPMENT OF AN AIRPORT is planned by the Civic Airport Committee of Vancouver, B. C., which has purchased options on a site of 459 acres on Sea Island, at the mouth of the Fraser River. A proposition to raise and appropriate $200,000 will probably be submitted to the ratepayers in December.

RAILWAY ELECTRIFICATION PLANS in England have been announced by the Southern Railway, which will shortly begin work on converting the lines from London to Brighton, 51 miles, and from Preston Park to Hove and Worthing, 11 miles, to electric operation. Similar work on a 20-mile line from Redhill to Guilford is also contemplated. The Southern Railway is using the direct-current, third-rail system.

TWO BRIDGES across the Rhine River in Germany have recently been opened to traffic. An old bridge between Mülheim and Rieho has been replaced by a suspension bridge with a width of 89 ft. and a total length of 4,000 ft., including a suspended span of 1,032 ft. Between Düsseldorf and Neuss a steel bridge with a total length of 2,560 ft., a center span of 666 ft. and a width of 100 ft. has been opened to vehicular traffic. On this bridge, the upper chord takes the form of a catenary.

CHRYSLER BUILDING APPROACHES COMPLETION

Wide World Photo

Steelwork for the Chrysler Building in New York City has been completed at a height 808 ft. above the ground level. The building, which is 16 ft. higher than the Woolworth tower, will be surpassed in height only by the new Bank of Manhattan Building, 840 ft., and the projected City Bank-Farmers Trust Company building, 925 ft.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

I.C.C. Hopes to Present Railroad Consoildation Plant to Congress—Local Control of Interstate Buses

HOPE has been expressed again by Commissioner Claude R. Porter that the Interstate Commerce Commission's final plan of railroad consolidation will be ready for Congress when the regular session convenes in December, or soon thereafter. Commissioner Porter has intimated that as railroad consolidation is voluntary, the commission is endeavoring, subject to limitations imposed by public interest, to arrange groupings that are sufficiently advantageous to afford an incentive to the carriers to go forward with consolidations.

That the plan will not be the commission's last word on the subject is gathered from Commissioner Porter's emphasis upon the fact that the commission may, upon its own motion or upon request, make such changes or modifications in the plan as in its judgment will be in the public interest. The fact that some latitude may be exercised by the commission later probably will be helpful in enabling the members to reach an agreement on the plan to be presented to Congress.

The final plan is expected to present radical changes from the tentative plan published in 1921. There is practical assurance that unifications approved by the commission in the meantime will not be disturbed, although authorized subject to the conclusions reached by the commission upon a final plan. The final plan will go beyond the tentative plan and endeavor to provide for the disposition of short or weak lines. The proposals of the tentative plan were confined almost exclusively to Class I carriers.

Bus Regulation

Just how far local utility commissions may go in regulating the operations of interstate bus lines is now being tested in the District of Columbia courts. The District of Columbia Public Utilities Commission has designated certain routes for the interstate bus carriers to follow in passing through the streets of Washington. One of the lines deviated from the fixed route and persisted in its deviation after notification had been served by the commission.

A fine of $1,000 was assessed against the operator for this infraction. The bus line has protested the levying of this fine and the matter has been referred to the courts. The issue has given rise to the question of whether or not the language of the proposed interstate bus bill should be strengthened in respect to the police powers that may be exercised by the cities. Representatives of the utility bodies of several states are now taking the position that it should be specifically mentioned in the pending bus bill that the various states and municipalities shall fix the routes over which interstate bus carriers shall operate in their territory. It is also being urged that something be done to give cities direct authority to regulate the use of terminals by interstate bus lines.

Rail-Barge Rates Postponed

The Interstate Commerce Commission has postponed until Feb. 24, the effective date of its order entered last April prescribing establishment of through routes and joint rates between the government barge line and the railroads. Operation of the order previously had been postponed until Nov. 25 pending the preparation of the joint rail-and-barge tariffs.

Soil Erosion and Control

Acting on the request of the American Society of Agricultural Engineers, the American Engineering Council will appoint a committee to advise with the U. S. Department of Agriculture and state and private agencies on organizing some agency to correlate present activities in the field of soil erosion and control. Last year the Department of Agriculture had an appropriation of $160,000 for soil erosion work. This was distributed among the Bureau of Public Roads, the Bureau of Chemistry and Soils and the Forest Service. For the fiscal year ending June 30, 1931, the department will request an appropriation three or four times as large. It is now conducting experiments on three farms located in different sections of the country.

Personal Notes

William C. Cushing, engineer of standards of the Pennsylvania Railroad, has been elected to honorary membership in the American Railway Engineering Association, an honor that has been conferred on only five other men.

John C. Dickerson has been named city manager of Plant City, Fla., succeeding E. H. Thompson, who resigned several months ago. Mr. Dickerson designed and built the sewage-disposal plant of Plant City.

Howard H. Parsons, chief engineer of the Hempstead (N. Y.) Development Commission, has been appointed chief engineer of the town of Hempstead Zoning and Planning commissions. He has also been retained as zoning consultant for the village of Hempstead in addition to being elected to the directorate of the Nassau County Planning Federation. Mr. Parsons lately became associated with Edward M. Bassett, of New York City, in zoning on Long Island.

L. A. Montgomery has been transferred from the operating department to the Calipatria (Calif.) office of the Southern Sierras Power Company.

Paul K. Freese, engineer and contractor, of Chicago, has located his office in Gary, Ind., and has taken over the drafting department of the Walter Bates Steel Corporation on a contract basis.

Joseph K. Port, of Wilmington, Del., is now on the staff of the engineering department of the Kimberly Clark Corporation at Neenah, Wis. Previously Mr. Port was in the engineering department of the Pyrites Company at Wilmington.

A. L. Martin, formerly manager of the Mountain States Power Company at Marshfield, Ore., has been transferred to Thermopolis, Wyo., where he will hold a similar position with the same company. Thomas H. Ness succeeds Mr. Martin at Marshfield.

Thomas G. Lanphier, vice-chairman of the technical committee of the Transcontinental Air Transport, has accepted a position as senior aeronautical engineer with Ford, Bacon & Davis, Inc., engineers, of New York City.

W. L. Picton, of Nashville, Tenn., who was formerly associated with the firm of Klyce & Harrub, municipal engineers, has become associated with the Clark E. Jacoby Engineering Company, of Kansas City and St. Louis, Mo., engaged in engineering practice, specializing on flood control, drainage and sewer improvements.

Harold Ward Gardner, head of the department of civil engineering and mechanics at the Colorado School of Mines, has been admitted to the bar in Colorado. Mr. Gardner is at present chief engineer for the city of Golden, Colo., in charge of the reconstruction of the emergency pipe line that supplies the city with water.

Don C. Tripp, testing engineer at the State Agricultural College, Fort Collins, Colo., has resigned to accept a position with the Missouri state highway department. He is succeeded by Carl Carpenter, formerly associated with the engineering department of the Union Oil Company of California.

W. R. Eberhardt, who for ten years has been structural and contract engineer for the H. K. Ferguson Company, Cleveland, Ohio, has been appointed manager of that company's New York branch office. During the past year Mr. Eberhardt has been in charge of several large chemical plant operations which the Ferguson company is building at various points in the East.

Society Calendar

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington; annual meeting, San Antonio, Tex., Nov. 12-15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; annual convention, Biloxi, Miss., Nov. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

INTERNATIONAL CITY MANAGERS ASSOCIATION, Chicago; annual convention, Fort Worth, Tex., Nov. 20-23.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington; annual meeting, Chicago, Ill., Dec. 4-6.

Construction Equipment and Materials

Steel Founders Want Cost Records of Production

More attention to close accounting of production costs and more publicity to widen the field and spread the advantages of large and small steel castings for various purposes was the policy outlined at the annual meeting of the Steel Founders Society of America, held at Chicago on Oct. 29 and 30. Officers re-elected for 1929-30 include: president, J. S. McCauley, Pittsburgh, Pa.; managing director, G. P. Rogers, New York, N. Y.

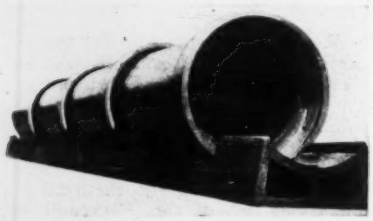
New Developments

Surfacing Metal Applied by Welding Process

High wear-resistant surfaces for tools used in cutting metal, drilling rock and for other purposes where wear-resistance qualities are necessary can be provided by means of Wildite Type-T metal manufactured by the Fusion Welding Corporation, Chicago, Ill. This material is a complex alloy steel differing from the usual surfacing metal in that it is not only hard but in addition possesses ductility to an unusual degree. It is furnished in two forms, Type T-G, for oxyacetylene application, and Type T-E, for application by the arc-welding process. When carefully applied, the two types of deposit will show a Brinell hardness of approximately 600 and 625 respectively. Weldite Type-T metal is a development of the research department of the Fusion Welding Corporation.

Tile Drain Supports Sewer Pipe

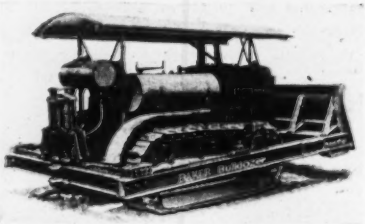
Vitrified tile sub-drain shaped to form a cradle to support and strengthen sewer pipe is now being manufactured by the Ric-Wil Company, Cleveland, Ohio. This is made for use with pipes of all diameters up to and including 15 in. and in 2-, 2½- and 3-ft. lengths. Use of the sewer base, according to the manufacturers, effects many economies in installation. The trench is dug and graded and the cradle base sections are laid in, the alignment being checked by means of beads in the center of each base. Then the sewer pipes are laid into place, the points are filled and the backfill is placed. Spaces molded in the base blocks provide for the bells of the pipe, so that no bell holes need be dug. The load is distributed through the bases through a broad flat surface to solid ground unweakened by sub-drains.



DRAIN-BLOCK SUPPORTS FOR SEWER PIPE

Bulldozer for Heavy Work

Bulldozer attachments for tractors are now being manufactured by the Baker Manufacturing Company, Springfield, Ill., in larger sizes for use with Caterpillar 30 and 60 tractors. The moldboard, constructed of heavy steel plate, is attached to a frame which entirely surrounds the tractor and is pivoted to it at the rear. Mounted forward of the center of the frame on each side is a heavy steel bracket connected by roller chains to hydraulic rams at the rear of the machine, the vertical action of which lift the moldboard off the ground to the required height. Power derived from the tractor transmission drives a gear pump which supplies light engine oil to the hydraulic cylinder rams. A relief valve limits the pressure of the oil to 750 lb. per square inch.

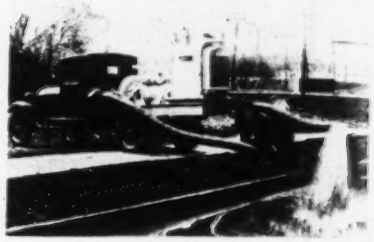


HYDRAULICALLY OPERATED BULLDOZER

Non-Clogging Trash Pump Made in Portable Form

For economical handling of fluids containing solids and foreign matter, particularly of fibrous or stringy character, a trash water pump, mounted for portable service, is being produced by the C. H. & E. Manufacturing Company, Milwaukee, Wis. The pumps used are made by Fairbanks, Morse & Company, Chicago, Ill., and the unit is being marketed by both organizations.

The pump is designed to handle solid spheres as large in diameter as the pipe size next smaller than the suction connection. It will pass any object which will enter the suction nozzle through a right-angle bend, and requires no nozzle strainer at the intake. A single bar across the end of the suction hose keeps out bricks, tin cans or other objects which might clog the hose. A simple and effective priming device is provided, consisting of a small brass vacuum pump driven by friction from the flywheel of the engine. This is connected to the highest point of the pump shell, and exhausts air from the pump and hose. After priming is completed, the vacuum pump is thrown out of contact with the flywheel and does not run until needed again.



GASOLINE-DRIVEN TRASH PUMP ON MOTOR TRUCK MOUNTING

Pumping units are available with either gasoline or electric motor drive on four types of mounting: for motor trucks; on either steel- or rubber-tired wheels with or without spring mountings; or on steel skids. Intake sizes vary from 4 to 8 in., engines from 15 to 45 hp., and capacities from 400 gal. per minute at 50-ft. head to 2,500 gal. per minute at 35-ft. head.

Self-Contained Screening Plant Operated by One Man

By combining a Leahy screen and a Barber-Greene bucket loader, with slight modifications of both, the Barber-Greene Company, of Aurora, Ill., has developed a one-man excavating, loading and screening plant which is a complete unit—self-propelled, self-loading and self-contained. The bucket loader has the standard B-G features, including the automatic safety sprocket, the full crawler mounting with three-point suspension, and the patented disk feed.

When the loader discharges the gravel, it first strikes a deflector which breaks the impact and spreads the material over the primary screen. This is a heavy, square-mesh screen inverted over the main screen like a roof and vibrated by a take-off arm from the same drive that vibrates the main screen. This primary screen spreads the material again to insure better separation by the main screen below, and

SCREENING PLANT DISCHARGING GRAVEL

rejects the oversize material through two chutes onto a conveyor which runs beneath the main screen. After the material has been shaken through the primary screen, it falls onto the main screen, a 4x5-ft. fine-mesh screen, vibrated by the loader power unit. This screen is made with several mesh sizes and can be set at any angle from 28 to 35 deg. by a lever within reach of the operator. The material selected by this screen is chuted off directly behind the loader into trucks; the fines which fall through it drop onto the conveyor and are carried off with the oversize. In case sand is desired, a gate in the mouth of each of the oversize spouts is flopped open, allowing the oversize rejected by the primary screen to fall directly to the ground instead of falling on the conveyor. Then, since the smaller gravel is thrown off by the main screen and the oversize is dropped through the spouts to the ground, the conveyor carries nothing but clean sand to the truck on the side.

Hoist Attachment for Tractor

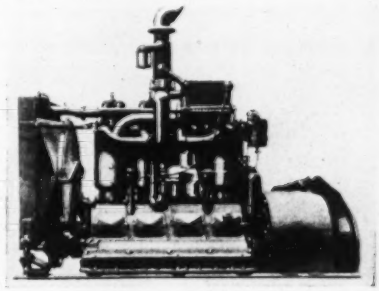
Designed originally for oil-field service, the hoist for Caterpillar tractor attachment manufactured by the Luther Manufacturing Company, Inc., Olean, N. Y., is adaptable for many other hoisting purposes. It is provided with a drum with a capacity of 2,615 ft. of

CABLE STORAGE ON DRUM PERMITTED BY ADJUSTABLE DIVIDER

$\frac{3}{4}$-in. cable or 930 ft. of $\frac{7}{8}$-in. cable. A special feature is the drum divider, which provides space on the drum for spare cable and permits the use of a short line without loss of leverage. The cable line speed is 122 ft. per minute, with an engine speed of 1,000 revolutions per minute. The power take-off is equipped with heat-treated gears, is ball bearing, and is lubricated by an oil bath. Braking is provided by an asbestos-lined brake band 24 in. in diameter by 4 in. wide, well supported to prevent dragging.

Engine Uses Low-Grade Fuel

For crane and shovel service an engine based on gasoline motor principles, having the usual ignition system but using lower-priced fuel, has been developed by the Northwest Engineering Company, Chicago, Ill. Because of its similarity to the ordinary gasoline motor, maintenance can be taken care of by any operator or truck driver, eliminating the necessity for special mechanics. Essential features of the new engine are: (1) a carburetor developed especially for fuels with a distillation range from 195 to 365 deg. C.; (2) adequate vaporization of the heavier fuels to permit clean burning under

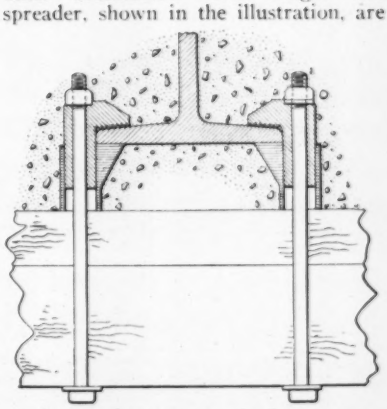


OIL BURNING ENGINE FOR CRANE AND SHOVEL SERVICE

varying conditions of load; (3) special combustion chamber shape to promote clean combustion and the suppression of undue detonation; (4) special means to eliminate the dilution of lubricating oil. When cold the engine is started on gasoline, the heavier fuel being used after a few minutes of running.

Hanger Supports Forms for Beam Incasement

Malleable-iron hangers and spreaders for supporting forms used in the incasement of structural steel beams made by the Dayton Sure Grip & Shore Company, Dayton, Ohio, eliminate the use of shoring, enable slabs to be poured without the use of floors beneath for bracing and, after forms are removed, provide fastening for pipes, conduits and other accessories. The hanger and spreader, shown in the illustration, are



ASSEMBLING FORM FOR I-BEAM INCASEMENT

assembled in holes drilled in the beam bottom and beam bottom batten. After assembly, these members are hoisted into place and supported by ropes while the hanger and spreader are fitted over and under the I-beam flange, after which the nuts are tightened until the beam bottom becomes perfectly rigid. This tightening can be done either from the top or from the bottom. After the forms are removed, the nuts remain in place, providing a substantial insert for pipe hangers or other accessories.

New Publications

Air Compressors—INGERSOLL-RAND COMPANY, New York City, is distributing a 64-p. illustrated catalog of portable air compressors mounted on trailers, motor trucks and skids.

Pipe Coating—LEWIS ASPHALT ENGINEERING CORPORATION, New York City, is distributing an 11-p. booklet, "Protecting Pipe Lines Against Corrosion," by A. Saunders, research engineer for the corporation.

Floor Grating—WALTER BATES STEEL CORPORATION, Gary, Ind., describes "Copper-quad" floor grating in a 12-p. illustrated pamphlet.

Safety Equipment—MINE SAFETY APPLIANCE COMPANY, Pittsburgh, Pa., has issued a new general catalog of 160 pp. covering equipment for safety appliances for all kinds of industrial and construction work.

Iron—AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has issued a 32-p. illustrated booklet "How Armco Ingot Iron Saves in the Oil Industry."

Squirrel-Cage Motors—LOUIS ALLIS COMPANY, Milwaukee, Wis., describes explosion-proof self-ventilated ball-bearing squirrel-cage motors in sizes from $\frac{1}{2}$ to 25 hp. in an 11-p. illustrated bulletin 508.

Ball Bearings—NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., in a 16-p. illustrated pamphlet describes a new type steel bearing for small pumps, air-driven tools and similar equipment.

Tractors—CATERPILLAR TRACTOR COMPANY, San Leandro, Calif., has issued a series of booklets on the uses of its products. "Moving Things" shows Caterpillar tractors in use in a variety of industries, while separate booklets cover the use of tractor power in manufacturing, the oil industry, for improving and maintaining airports and other areas, by public utility companies and in mines and quarries.

Electric Heat—GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published two illustrated booklets, "Electric Heat in Industry" and "Electric Furnaces." These relate to the application of electric heat to groups of basic industries commonly found in industrial plants and to the apparatus used for this purpose.

Ball Bearings—GURNEY BALL BEARING DIVISION, Marlin-Rockwell Corporation, Jamestown, N. Y., has issued a 202-p. ball-bearing manual covering the design and application of ball bearings for all types of uses. Although prices are given in the volume, it is primarily a book of engineering data.

Floor Hardener—STONHARD COMPANY, Philadelphia, Pa., discusses the use of its products in preventing and repairing disintegration of concrete floors in a 12-p. illustrated booklet.

Timber—J. F. PRETTYMAN & SONS, Charleston, S. C., has issued two booklets, "Mechanical Properties of Certain Woods Used for Poles" and "Air Seasoning of Timber and Climatological Conditions Which Affect It." Each of these contains valuable engineering data.

Cast Iron—DURSAR CORPORATION, Newark, N. J., has issued a 4-p. pamphlet describing Perlit, a special type of high-test cast iron produced by a foundry process developed in Germany.

Irrigation Equipment—BURNHAM MANUFACTURING COMPANY, Woods Cross, Utah, in a 70-p. catalog and price list gives directions for installing irrigation equipment and considerable hydraulic data of use to irrigation engineers.

Inspecting and Testing—PITTSBURGH TESTING LABORATORIES, Pittsburgh, Pa., describes in a 32-p. illustrated book the services which it renders to its clients.

Pneumatic Tools—SULLIVAN MACHINERY COMPANY, Chicago, Ill., in two new illustrated bulletins describes pneumatic clay spaders and concrete breakers. The latter can be furnished with special heads for driving sheetpiling.

Steel Roofs—TRUSCON STEEL COMPANY, Youngstown, Ohio, gives instructions for laying Ferrobord Roof Decks in a 20-p. illustrated pamphlet. A separate pamphlet gives erection data and specifications for Truscon I-Plates, another form of steel-roof construction

The Business Side of Construction

October Lettings 18 Per Cent Under Average for Year

FOR the first time this year monthly contracts for engineering construction fell below $300,000,000. In millions of dollars the weekly average for October was 66, compared with 81 in September, 88 a year ago, 80.5 for the 1929 average and 69 for the 1928 average. Thus the month's total is 18 per cent under the weekly average for the ten months of this year and 4 per cent under the weekly average of last year.

While October is generally the smallest contract month of the year, October, 1928, was the record month for that year and was 27.5 above the average. Last year's October total included ten contracts which totaled $145,656,000, or 41 per cent of the month's total. The largest of these ten was the water tunnel from Yonkers to Brooklyn, $42,692,568. Four building contracts totaled $35,000,000. Other contracts were a hydro-electric plant at Augusta, Ga., $20,000,000; rayon plant, Asheville, N. C., $10,000,000; gas pipe line, $8,000,000; subway in New York, $4,813,000; steam power plant, $25,000,000. Last month's total included only three unusually large contracts: a New York apartment, $8,000,000; power plant, Safe Harbor, Pa., $30,000,000; tube mill, McKeesport, Pa., $20,000,000.

One month ago the year's total was 20 per cent above 1928; the lead now is 17 per cent.

Public construction in the first ten months of 1928 amounted to 40 per cent of the total, while this year the figure is 33 per cent, due to a general falling off except in highway bridges and federal government work. The difference in water-works values is almost entirely due to the Yonkers-Brooklyn tunnel. Street and road lettings, which started slowly this year and have been gradually catching up, are now only 14.3 per cent behind the record lettings of 1928. Bridge contracts this year very slightly ahead of those of Industrial building contracts were traordinarily heavy and public buildings are a little ahead of last year, the great group of other buildings only 1.5 per cent ahead of a year ago. A large volume of unclassified structures have been placed under contract this year.

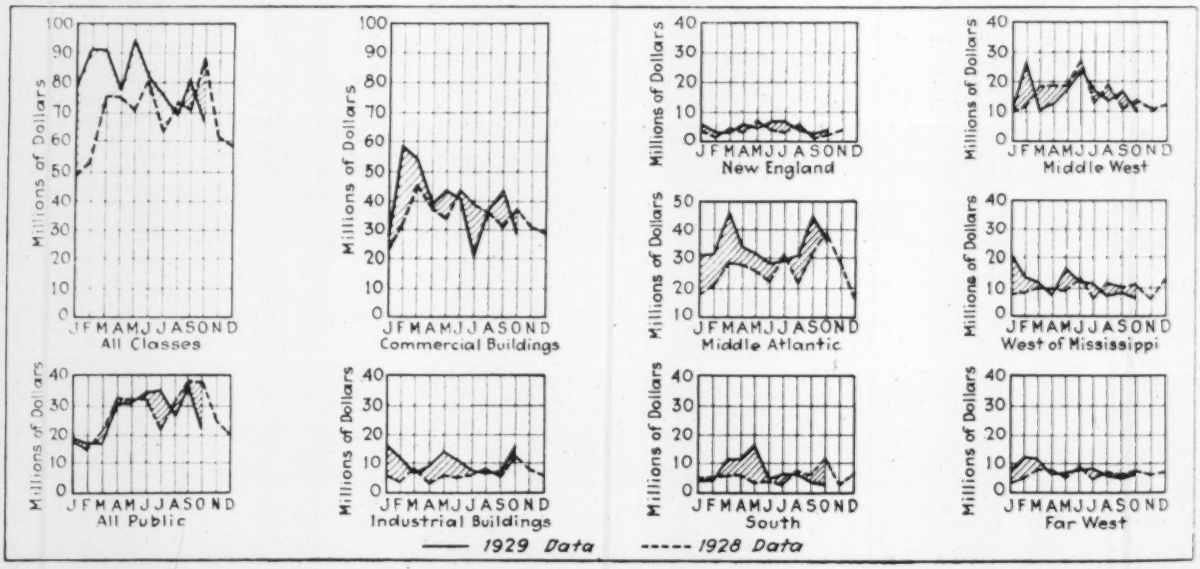
Geographically, contracts are ahead this year except in the Middle West (slight decline) and in the region between the Mississippi and the mountains.

The stock market depression occurred in the last week of the month, when engineering contracts totaled $95,000,000, compared with $56,000,000 the week before and $90,000,000 in the same week of 1928. This figure includes the power plant and tube mill before mentioned, totaling $50,000,000. In commenting on the break in stock prices, Julius Klein reminds that next to retail trade, the principal commodity demand is for expanding capital equipment, which means factories with their equipment, public works and other engineering construction. He looks for no diminution in demand for capital goods, but "on the contrary, the diver

VALUE OF CONTRACTS AWARDED IN THE UNITED STATES AND TOTAL FOR CANADA, OCTOBER, 1929

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States October, 1929	United States Year to Date 1929	United States Year to Date 1928	Canada October, 1929
Water-works	$310	$2,456	$240	$1,340	$602	$1,448	$6,396	$43,360	$85,705	$30
Sewers	210	2,229	429	3,796	1,665	1,331	9,660	77,905	86,389	37
Bridges	494	4,019	496	1,142	2,672	1,626	10,449	120,874	102,437	204
Excavations, etc.	98	323	140	209	129	24	923	25,851	31,584	419
Streets and roads	1,465	18,984	4,719	8,238	12,034	6,545	51,985	487,515	557,625	1,362
Industrial buildings	2,780	57,333	3,745	4,621	6,659	6,707	81,845	481,844	286,895	2,265
Commercial buildings	12,200	81,699	3,810	21,660	8,322	15,330	143,021	1,775,579	1,585,663	750
Federal government	396	739	651	731	2,698	1,434	6,649	96,795	59,834	
Unclassified	686	12,154	199	3,462	1,652	853	19,006	443,716	239,327	4,611
October, 1929, 5 weeks	18,639	179,936	14,429	45,199	36,433	35,298	329,934			10,291
September, 1929, 4 weeks	14,289	175,173	16,157	65,286	35,148	19,728	325,781			9,224
October, 1928, 4 weeks	12,556	156,484	45,146	56,319	51,463	30,666	352,634			14,900
Year to date, 1929	207,177	1,504,043	305,819	684,662	518,872	330,866		3,551,439		166,825
Year to date, 1928	189,022	1,168,878	248,490	704,502	447,938	276,629			3,035,459	132,053

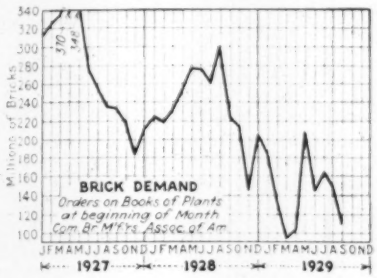


CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. BY CLASSES—ALL CLASSES BY SECTIONS

...n of capital from stock market ...culation to direct productive enter...ises might readily increase the de...and for commodities of this sort."

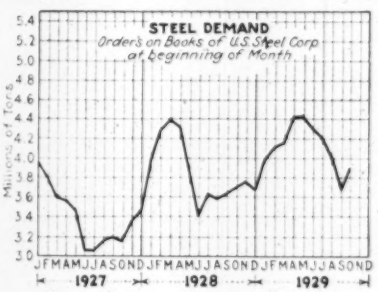
Industry Makes and Builds More Than Year Ago

Reports from many industries show activity strong in September and appreciably above that of last year. Slight reductions in the iron and steel and the automotive industries were balanced by increased operations in several textile branches, according to the National Industrial Conference


BRICK DEMAND
Orders on Books of Plants at beginning of Month
Com. Br. M'f'rs. Assoc. of Am.
Millions of Bricks
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

Board. Increased rainfall improved even agricultural prospects, with prices equal to those of a year ago.

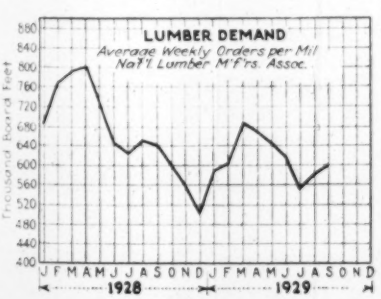
Automobiles produced in the first three quarters reached 4,870,000, or 269,000 more than for the entire year 1928. It is therefore expected that slowing down in the present quarter will be greater than usual. Foreign sales are up 40 per cent. New registrations, in-


STEEL DEMAND
Orders on Books of U.S.Steel Corp. at beginning of Month
Millions of Tons
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

cluding trucks, gained 37 per cent over the registrations in 1928.

September use of crude rubber was 9 per cent above that for August, and for the nine months 14 per cent over that for 1928.

Crude petroleum output for the first eight months increased 82,000,000 bbl. over that of 1928, with August the peak. Gasoline production is up 41,000,000 bbl., though domestic consumption in-


LUMBER DEMAND
Average Weekly Orders per Mill
Nat'l Lumber M'f'rs. Assoc.
Thousand Board Feet
J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929

creased only 31,000,000. Imports increased 2,000,000 bbl., with exports down 5,000,000. Production declined in October.

The machine tool index of gross orders was 265.8 for September and 286.1 for August, but the apparent backlog represents nearly three months' capacity operation.

Bituminous output in September was 1 per cent over that in August, but on the basis of daily output the increase was 12 per cent.

Industrial Building

In keeping with all this productive activity, plant construction this year has been much greater than it was last year. The accompanying table gives number and value of contracts awarded in six leading industries in the first nine months. The seven projects listed in the footnotes account for 78 per cent of this tremendous increase. Total industrial building in the first ten months of 1929 exceeds last year's value by 68 per cent.

INDUSTRIAL BUILDING IN FIRST NINE MONTHS
(Contracts of $40,000 or More)

	1928		1929	
	No.	Value	No.	Value
Aircraft	6	$601,000	20	$12,368,000
Automotive	153	30,636,000	224	22,480,000
Electric power plants	87	29,992,000	116	*103,561,000
Iron and steel	87	10,020,000	92	† 26,793,000
Machine shops	43	8,841,000	82	‡ 11,933,000
Petroleum prod'ts	24	4,986,000	27	§52,419,000
Total	394	$85,076,000	561	$229,554,000

* $6,175,000 hydro, Hot Springs, Ark.; $9,000,000 Pittsburgh; $30,000,000 Osage, Mo.; $10,000,000 Atlanta.
† $10,000,000 pipe plant, Ambridge, Pa.
‡ $3,493,400 C. & O. shops, Huntington, W. Va.
§ $45,000,000 refinery, Mariner Harbor, N. Y.

New Capital $1,615,000,000; For Construction $300,000,000

New securities issued in September not only exceeded those of all other Septembers but of any other month as well. Of the total of $1,615,000,000, $308,000,000 is for refunding. Of the remainder, $98,000,000 is for public bonds and $8,000,000 for foreign governments. There remains $1,201,000,000 domestic corporate issues. It is noteworthy that of this huge volume, only $240,000,000, or 15 per cent at most, is for new construction. There is $318,000,000 for the railroads, public utilities and manufacturing industries for acquisition, consolidation and retirement. The remaining $643,000,000 was floated by investment trusts and holding companies. This investment factor is 32 per cent more than it was in August and more than ten times as much as it was in September, 1928.

Excluding refunding issues, the total for the nine months was $8,490,000,000, of which $918,000,000 was for long-term public bonds, compared with $962,000,000 for that period of 1928 and $1,152,000,000 for 1927. There has been a notable decline in foreign government securities, from $486,000,000 in 1928 to $65,000,000 this year. Of the large corporate total remaining, only 7 per cent were foreign loans. In the domestic corporate total, there is the significant figure of $3,096,000,000, or 42 per cent, for miscellaneous, of which by far the largest element is investment trust, holding and insurance companies. In percentages of totals this element in the years 1928 to 1925, respectively, were 22, 15, 11 and 8.

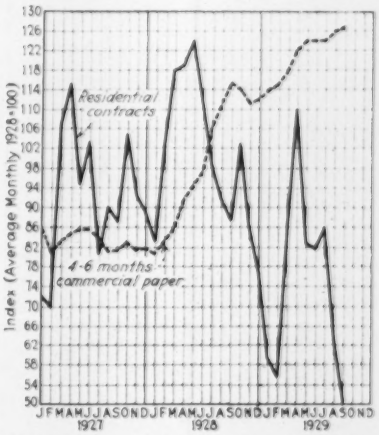
Corporate common stock except refunding amounted to 71 per cent of the September total and 23 per cent in September, 1928. For the nine months common stock amounted to 51 per cent and 27 per cent in 1928.

Among the large issues of the month were $103,600,000 by Lehman Bros., $88,000,000 Bethlehem Steel Corporation, $65,000,000 Public Utility Holding Corporation of America, $95,000,000 Middle West Utilities Company, $78,000,000 Consolidated Gas Company of New York, $72,335,000 Chicago & Northwestern Railway.

High Money and Light Demand Cause Residence Slump

This year's 27 per cent drop in residential building was shown by chart in the Oct. 3 issue. The present chart shows one of the two principal reasons for the drop. Credit costs have risen to a point where speculative building is unattractive. Not only do first mortgages command the top legal rate but in addition they carry expense charges and bonuses and cover only 50 per cent of appraisal.

The second-mortgage situation is still worse. There is practically no market


Residential contracts
4-6 months commercial paper
Index (Average Monthly 1928=100)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929

INTEREST RATES AND RESIDENTIAL BUILDING

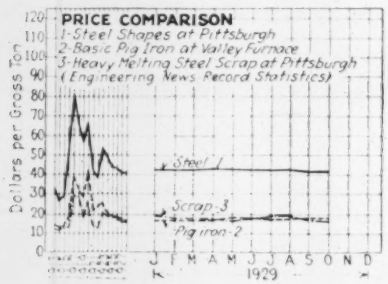
for these securities, with the result that builders and developers, who depend for capital upon the sale of these, have been forced to suspend operations.

The second reason for the drop in residential building is smaller need. This, however, is sure to be remedied with time, for population continues to grow. It is the development of this need or demand that will stimulate residential building, even despite high mortgage costs.

Materials Prices Weak

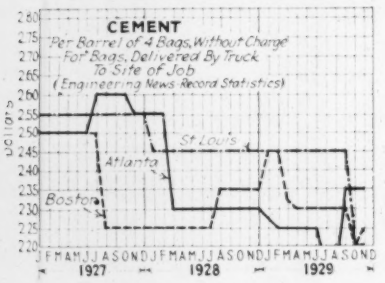
A year ago there were many price advances despite price cutting among retail dealers. The present situation is quite different. During the month price reductions were announced for plates; cement quotations are at bottom; the brick market is demoralized. Paint is the exception, linseed scarcity having raised prices.

Three-inch fir timbers are down 50c. to $1.50 at New York. The big price cut in fir was at Seattle. Kansas City and



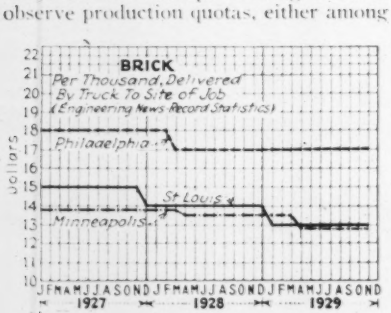
Montreal markets, on the contrary, show exceptional firmness. Pine appears less affected than fir; hemlock and spruce prices unchanged.

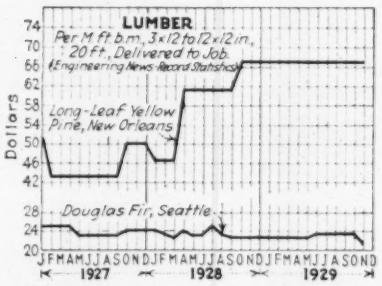
Lumber stocks are 5 per cent heavier than a year ago, with 9 per cent less business due to the drop in residential building. Production is 20 per cent below normal, which means restriction of output if prices are to hold. It is expected, however, that production will continue at the present rate, because,


CEMENT
Per Barrel of 4 Bags, Without Charge For Bags, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
St. Louis
Atlanta
Boston
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

although millmen may agree to the desirability of curtailment, they recognize the economy of mass production. Another way to maintain prices is to stop shipping unsold lumber, which is frequently sold under the market.

Cement manufacturers foresee no price changes in November, either mill or retail. Heavy mill stocks prevent recovery from the price declines of late summer. No attempt is being made to observe production quotas, either among


BRICK
Per Thousand, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
Philadelphia
St. Louis
Minneapolis
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929


LUMBER
Per M ft b.m., 3x12 to 12x12 in., 20 ft., Delivered to Job
(Engineering News-Record Statistics)
Dollars
Long-Leaf Yellow Pine, New Orleans
Douglas Fir, Seattle
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

companies or among units of a company, with the result that mill stocks (17,329,000 bbl.) are heavier than a year ago.

Demand for concrete aggregates in the Great Lakes producing regions is the lowest in years. No attempt has been made to stimulate demand by cutting prices.

That brick prices changed in only two of twenty important cities during the month is due to low demand and not to firmness. Dealers see no reason for lowering prices as long as high money rates continue to keep residential builders out of the market.

Following demoralization in the New York brick district comes the shutting down of yards in the Chicago district. New York producers blame imports, while Chicago calls it slack demand. In the New York district the closing down involved only the obsolete yards, which under no circumstances will reopen. In Chicago, on the other hand, there is deliberate curtailment of production.

White lead in oil rose 3.6 per cent to 14.25c. per pound, f.o.b. New York, on Oct. 22. This is the first change since March 19 and is plainly due to increased cost of linseed oil, since the latter has risen 42.7 per cent, to 16.1c., while pig lead has declined 8.7 per cent to 6.52½c., East St. Louis. Mixed paints in general, which advanced 25c. per gallon a month ago as a result of the rise in oil, remain at the new quotations. Trading in most of the pigments is dull.

Construction Cost and Volume Index Numbers

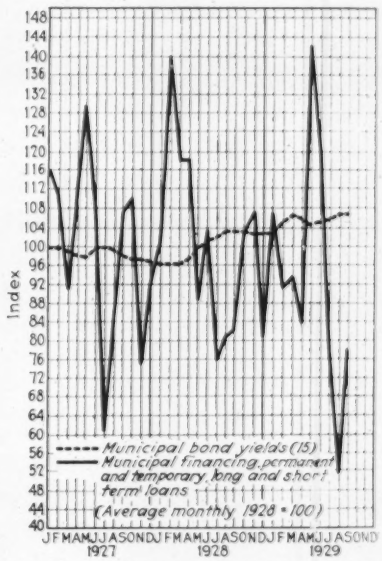
E. N.-R. Cost		E. N.-R. Volume*	
Nov., 1929	208.46	Oct., 1929	273
Oct., 1929	206.32	Sept., 1929	340
Nov., 1928	209.46	Oct., 1928	36
Peak June, 1920	273.80	1928 (average)	28
1928 (average)	206.78	1927 (average)	263
1913 (average)		100.00	
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266
August	207.29	August	306
September	207.29	September	296
October	207.71	October	363
November	209.46	November	251
December	210.16	December	244
1929		1929	
January	209.46	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290
September	207.57	September	340
October	206.32	October	273

*Corrected for price change since 1913.

Steel demand is for structural shapes and railway material, with lessened demand for automobile sheets, pipe and other forms. Sheet buying, other than automotive, is normal for the season. Prices are steady in iron and steel, but a trifle weak on scrap owing to light buying in the automobile industry. Plates dropped 5c., to $1.90, Pittsburgh, during the month, as did shapes one month ago.

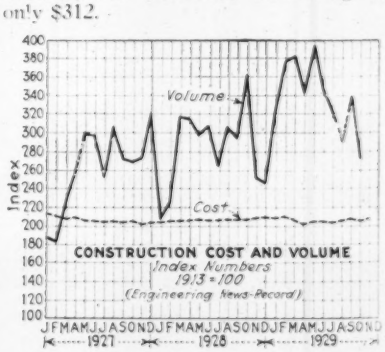
Upturn in Public Financing

Public bonds, which, in common with corporate bonds, suffered a severe decline in the last five months, took a turn for the better early in October and the immediate outlook is bright. Both long- and short-term issues are 4 per cent behind last year's volume. Long-term issues in September amounted to $97,000,000, compared with $80,000,000 in August and $67,000,000 the year before. October issues include $60,000,000 for constructing the New York-New Jersey


Index
Municipal bond yields (15)
Municipal financing, permanent and temporary, long and short term loans
(Average monthly 1928 = 100)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

PUBLIC BOND SALES AND YIELDS

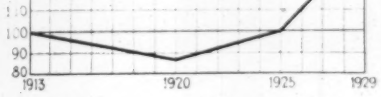
bridges. Detroit is expected shortly to ask bids for $25,000,000 improvement bonds. Numerous other flotations are expected to follow. A recent example of close bidding was in the case of the $5,200,000 Allegheny County 4¼s. The winning bid was 100.111; the next was 100.105, the difference amounting to only $312.


Index
Volume
Cost
CONSTRUCTION COST AND VOLUME
Index Numbers
1913 = 100
(Engineering News-Record)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

The *Bond Buyer's* index of municipal bond interest rates gives the average basis level for twenty large cities on Oct. 1 as 4.49 per cent; August and September, 4.41; Oct. 1, 1928, 4.16. The chart shows the average yield of fifteen issues and total financing for 1927 to 1929.

Labor Efficiency and Local Conditions

Last month it was shown here that one or more of the building crafts are working five days in only 130 cities; all crafts in eight cities. A study of the effect of the short week on building costs recently made by H. H. Fox, vice-president of the Turner Construction Company, indicates that man-hour production in the principal trades has been increasing since 1920 and on a 45 deg. angle since 1925. The chart shows the



AVERAGE MAN-HOUR PRODUCTION

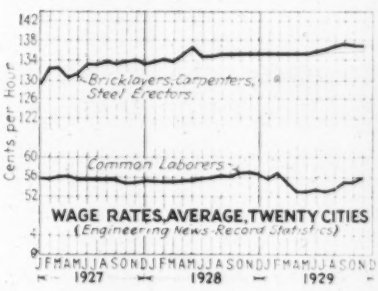
average efficiency of carpenters, strippers, concrete laborers, mechanics and laborers on reinforcement. Not only is this an average but the curve is characteristic of most of the individual trades.

It is pointed out that though the immediate effect of the five-day week in the building industry will probably be an increase in labor costs, this is not the first time that labor has received what amounts to a 10 per cent increase in wages and there is no evidence that previous increases have reduced building volume. Improvement in management and construction plants is another factor controlling costs, but it is recognized that buildings are custom-built and largely hand made and therefore the builders are less able to profit from mass production and better machinery than are manufacturers.

Last November there were no major strikes in the construction industry. Last month there were several strikes, some sympathetic, some jurisdictional wrangles. Higher wages are asked. Settlements in October favored the unskilled workers. Local conditions:

New York—Threatened strike of the compressed air, tunnel, foundation and sewer workers averted, pending negotiations with the subway contractors. Concrete workers, muckers and common laborers demand advance of $1.70 per day ($6.50); drill runners and helpers ask the same, to $9.50 and $7.50. Subway contractors, charged by the carpenters' union with having paid wages below the rate, countercharge that an agreement between the Building Trades Employers' Association and the carpenters' union does not determine prevailing rate. This rate, it is claimed, should be based on the wages of the total number of carpenters employed in the city. Moreover, a state Department of Labor ruling holds that the formbuilders employed in subway construction, who receive considerably less than carpenters, are not carpenters.

Syracuse—A few plasterers are still on strike, though most returned to work following the ruling that out-of-town plasterers are to receive the local rate of $12, instead of $13, as formerly.



Columbus (Ohio)—Unions charge sewer contractors compel men to work twelve hours in violation of the eight-hour law and that contractors bring in laborers from other states with local labor unemployed.

Chicago—Steamfitters awarded advance of 7½c. ($1.70) thus averting strike for $1.75. Journeymen agree to accept time and a half instead of double time. Painters agree to work straight time basis on emergency overtime. With half of Chicago's 110,000 building mechanics out of work, this city approaches Philadelphia in matter of construction depression.

Birmingham—Construction slow, with manufacturing increasing. Industrial labor shortage expected Jan. 1. Several manufacturing plants which have been idle for some time recently opened. One is a mill of the Tennessee Coal, Iron & Railroad Company, employing 500 men. The Pullman Car Building Company has just opened large new plant, employing several hundred men. Many carpenters, brick masons and other building trades mechanics unemployed.

St. Louis—Plumbers' helpers returned after week's strike, accepting 75c. for construction and 67½c. for maintenance work. Strikers had asked advance from 60c. to flat rate of 75c. This is another city where industries, except construction, are notably active. Business in eight of the principal plants is gaining and is slowing down in four.

Detroit—Unemployment in construction aggravated by release of men from automobile factories.

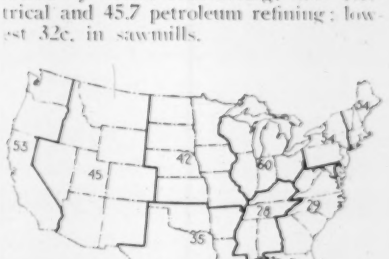
Skilled building trades mechanics receive an average rate of $1.36½ per hour, the same as in October. In November, 1928, the rate was $1.35½ per hour. The skilled rate in manufacturing is 67c.

Common laborers average 56.03c. compared with 54.96c. in October and 56.53c. in November, 1928. The average unskilled rate in manufacturing is 53c. per hour.

Entrance Rates for Common Laborers

A recent survey of thirteen industries in nine sections of the country shows 155,328 common laborers employed at an average entrance rate of 43.7c.; the highest was $1.188 for general contracting labor in the Middle Atlantic states; lowest rate 15c. for public utilities and general contracting in the South Atlantic states. Of the total number, 82,533, or 53 per cent, are employed in industries producing brick, tile, terra cotta, cement, iron, steel, lumber and general contracting. The other industries are automobiles, electrical machinery, foundry and machine shop, leather, paper, petroleum and meat.

The maximum for any industry was 49.9c. per hour in the automobile, followed by 48.3c. contracting, 45.9 electrical and 45.7 petroleum refining; lowest 32c. in sawmills.



AVERAGE ENTRANCE RATE FOR COMMON LABOR, CENTS PER HOUR

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES* PER HOUR

Advances since last month are indicated by **heavy type**, declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50		$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.00@1.37½	65	$1.00	1.00@1.25	35
Birmingham	1.50	1.00	1.25	50		1.25	20 @ 35
Boston	1.50	1.37½	1.37½	85	1.27½	1.37½	45 @ 80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	40 @ 60
Chicago	1.70	1.62½	1.62½	97½	1.62½	1.62½	97½
Cleveland	1.62½	1.37½	1.37	87½	1.10	1.50	40@.87½
Dallas	1.67½	1.12½	1.25	50 @ .75	1.25	1.25	35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	87½@1.00		1.25	.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	90	1.00@1.10	1.00@1.25	.37½@.60
Kansas City	1.50	1.25	1.25	90	1.25	1.25	.50@.75
Los Angeles	1.25	1.00	1.00			1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	87½	.75		1.00	.40@.60
Montreal	1.25	.80	75		90	1.00	35
New Orleans	1.50	90	1.25	75	80@1.00	1.25	30@.40
New York	1.87½	1.65	1.92½	1.18¾	1.10@1.23¾	1.92½	1.03½
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	45@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½		1.50	40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.62½	40@.87½
San Francisco	1.37½	1.12½	1.12½	87½	1.12½	1.37½	68¾
Seattle	1.50	1.12½	1.12½@1.25	1.00	1.12½	1.25	70

*Minimum rates are for construction other than buildings, non-union.

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per barrel, *without charge for bags*, cash discount not deducted. Prices marked f.o.b. are manufacturers'; others are delivered by truck to contractors:

	Nov. 7, 1929	One Month Ago	One Year Ago
Atlanta	$2.35	$2.35	$2.30
Baltimore	2.40	2.40	2.65
Birmingham	2.40	2.40	2.60
Boston	2.25	2.15@2.25	2.35
Cedar Rapids (f. o. b.)	2.04	2.04	2.24
Chicago (f. o. b.)	1.85	1.85	2.05
Cincinnati (f. o. b.)	1.92	1.92	2.22
Cleveland (f. o. b.)	1.94	1.94	2.24
Dallas	2.15	2.15	2.15
Davenport (f. o. b.)	2.04	2.04	2.24
Denver	2.61	2.61	2.85
Detroit (f. o. b.)	1.95	1.95	1.95
Duluth (f. o. b.)	1.84	1.84	2.04
Indianapolis, (f. o. b.)	1.89	1.89	2.19
Jersey City	2.60	2.60	2.35
Kansas City, Mo.	2.65	2.65	2.17
Los Angeles	2.42	2.42	2.66
Milwaukee (f. o. b.)	2.00	2.00	2.20
Minneapolis (f. o. b.)	2.02	2.02	2.22
Montreal (f. o. b.)	**2.05**	1.70	1.41
New Orleans	2.65	2.65	2.40
New York	2.10	2.10	2.25@2.35
Peoria (f. o. b.)	2.02	2.02	2.22
Philadelphia	*2.10*	2.20	2.41
Pittsburgh (f. o. b.)	1.85	1.85	2.04
St. Louis	2.20	2.20	2.45
St. Paul (f. o. b.)	2.02	2.02	2.22
San Francisco	2.40	2.41	2.41
Seattle	2.70	2.70	2.70
Toledo (f. o. b.)	2.03	2.03	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Lehigh Valley District	$1.45
Buffington, Ind.	1.60	Limedale, Ind.	1.60
Chinchfield, Ga.	1.65	Mason City, Ia.	1.60
Hannibal, Mo.	1.80	Norfolk, Va.	1.90
Houston, Tex.	1.95	North Birmingham, Ala.	1.20
Hudson, N. Y.	1.55	Richard City, Tenn.	1.55
Ironton, Ohio	1.50	Steelton, Minn.	1.65
Iola, Kan.	1.65	Universal, Pa.	1.60
La Salle, Ill.	1.70	Wyandotte, Mich.	1.70

SAND AND GRAVEL—Per cu.yd., delivered by dealers. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds:

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	$2.65	$2.65	$2.00
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb. per cu.yd.)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.25
Chicago	1.90	1.90	1.80
Cincinnati, per ton	1.65	1.65	1.40
Cleveland (3,000 lb.) (2,700 lb.)	2.60	2.60	2.50
Dallas	2.50	2.50	2.50
Denver (2,700 lb. per cu.yd.)	1.80	1.80	1.30
Detroit (2,600 lb. per cu.yd.)	3.25	3.25	2.75
Kansas City, Mo.			
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.) (3,000 lb.)	2.40	2.40	1.10
Montreal, per ton	1.25	1.25	1.25
New Orleans (2,700 lb.) (2,500 lb.)	3.75	3.75	2.75
New York	3.25	3.25	2.00
Philadelphia, per ton	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh, per ton	2.20	2.20	2.40
St. Louis, per ton	2.25	2.25	2.00
San Francisco, per ton	1.75	1.75	1.75
Seattle (3,200 lb.) (2,850 lb.)	1.75	1.75	1.75

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Per cu.yd., delivered by dealers. Weight, 1½ tons per cu.yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	$2.65	$2.65
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	3.00	3.25
Boston, per ton	2.25	2.25
Chicago, Limestone (2,500 lb. per cu.yd.)	1.90	1.90
Cincinnati, per ton	2.25	2.25
Cleveland, per ton (2,500 lb. per cu.yd.)	2.70	2.70
Dallas	3.25	3.40
Denver, Granite (2,700 lb. per cu.yd.)	2.50	2.50
Detroit, Limestone, per ton (2,500 lb. per cu.yd.)	3.00	3.00
Kansas City, Limestone	1.85	1.85
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone (2,600 lb. per cu.yd.)	2.40	2.40
Montreal, per ton	1.90	2.10
New York, Limestone	3.25	3.25
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	2.75	2.75
St. Louis, per ton, (2,400 lb. per cu.yd.)	*1.90*	*1.90*
San Francisco, Trap rock, per ton	1.65	1.65
Seattle, (2,700 lb. per cu.yd.)	1.90	1.90

CRUSHED SLAG—Manufacturers' quotations on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.15	1.15		.80
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Building tile per block, delivered by dealers to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.072	$0.099	$0.135	$0.181	$0.202
Baltimore	.105		.20		.26
Birmingham	.09	.127	.174	.218	.261
Boston	.086	.115	.155	.19	.26
Chicago	.076	.104	.142	.182	.202
Cincinnati	.066	.09	.125	.16	.18
Cleveland	.064	.088	.128	.171	.19
Dallas	.095	.11	.17	.271	
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	**.184**	**.24**	**.265**
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0611	.081	.10605	.1302	.1752
Montreal	.12*		.22†		
New Orleans	.086	.118	.16	.212	.256
New York	.0864	.1296	.162		
Perth Amboy, N.J. (f.o.b.)				.2388	.295
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.068		.1175		.1728
St. Louis	.078	.104	.145	.175	.21
San Francisco	.108	.156	.255		
Seattle	.085	.115	.18		

*4x4x12. †8x8x12.

BRICK—Prices delivered by dealers per thousand, are as follows:

		Paving	
	Common	3x8½x4-in.	3½x8½x4-in.
Atlanta	$13.50	$38.00*	$45.00†
Baltimore	14.00	40.00	46.00
Birmingham	15.00	30.00*	34.00†
Boston	16.50	43.50	48.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	14.50	35.00	.....
Denver	11.00	.....	.....
Detroit	15.50	34.50	38.50
Kansas City	14.50	.....	.....
Los Angeles	**13.00**	.....	.....
Minneapolis	12.75	.....	.....
Montreal	*20.00*	.....	.....
New Orleans	16.50	40.00*	50.50
New York	14@15	45.00	51.00
Philadelphia	*16.00*	40.00	46.00
Pittsburgh	16.00	40.50	45.00
St. Louis	13.00	36.00	40.00
San Francisco	14.50	45.00*	
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3x8½x4.

LIME—Prices delivered by dealers to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$21.00	$13.50		
Baltimore	22.00	14.00	$2.55†	
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	**22.00**	14.75	4.00*	3.00*
Chicago	18.00	14.00	18.00‡	1.35†
Cincinnati	15.30	12.70	.....	.....
Cleveland	*16.00*	*12.00*	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	16.00	12.50	2.75†	2.50†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	19.75	.....	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21@23	14@15	4.10@4.20	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	21.00	19.00	2.50†	
St. Louis	24.00	18.00	2.75†	15.00‡
San Francisco	27.50	20.00	2.00†	
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.17@.20	Minneapolis	$0.15
Brooklyn and Queens	.12@.14	New Orleans	.22
Cleveland	.16@.17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$10.50@$14.50
No. 1 Ribbon	9.00@10.25
Medium Clear	9.50@11.25

Road and Paving Materials

PAVING STONE—Carloads or cargo lots of granite blocks, 4x8x4-in., dressed, f.o.b:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M.
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½x8x5 in.	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd.
San Francisco	

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2 25
Boston	3½	16	2 35
Chicago	3½	12	2 10
Cincinnati	3½	16	2 35
Dallas	3½	18	3 90
Kansas City	3½	16	2 75
Minneapolis	3½	16	2 75
Montreal	4	16	4 50
New Orleans	3½	16	2 50
New York	3½	16	2 70
St. Louis	3½	16	2 30

FLAGGING—Alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16 in., f.o.b., $1.00 per lin.ft.; roundings, $1.50 per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in tank-car lots, f.o.b. points listed:

	Package	Tank-cars
Atlanta (Mexican)	$20 40	$16 40
Baltimore (Standard Oil, f.o.b. refinery)	21 75	17 75
Birmingham (Mexican)	27 00	23 00
Boston (Mexican)	23 50	18 00
Chicago (Texas)	23 50	19 30
Cincinnati (Kentucky Rock)		12 30
Cleveland	24 00	20 00
Dallas (Texas)	27 37	
Denver (California)	35 00	*
Detroit (Mexican)	19 72	15 69
Kansas City, Mo. (Texas)	27 30	23 00
Los Angeles ("D" Grade, Calif., f.o.b., El Segundo)	18 00	12 00
Maurer, N. J. (Bermudez)	30 00	
Maurer, N. J. (Trinidad)	25 00	
Minneapolis, (Stanolind, f.o.b., Twin Cities)	24 10	19 10
Montreal (Imperial)	28 00	21 50
New Orleans (Texas)	24 00	21 00
New York (Texas)	22 50	18 50
Philadelphia (Mexican)	18 00	15 00
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Mexican)	21 50	17 50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18 00	12 00
Seattle, ("D" grade, Calif., f.o.b. Richmond)	18 00	12 00

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0 0525
Birmingham, 50@60% asphalt	0525
Dallas, 40@50% asphalt	0625
Dallas, 50@60% asphalt	0625
New York, 40@50% asphalt (at terminal)	05
New York, 50@60% asphalt (at terminal)	05
St. Louis, 40@50% asphalt	0342
St. Louis, 50@60% asphalt	0357

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	$14 50
Pittsburgh, basic, incl. freight ($1.76) from Valley	20.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3 10	3 10
Cleveland, warehouse, delivered	3 00	3 00
Dallas, warehouse, delivered	3 45	3 45
New York, warehouse, delivered, up to 3,999 lb.	3 30	3 30
Pittsburgh, large mill lots, f.o.b., (Oct. 31, 1929)	1 90	1 90
St. Louis, warehouse, delivered	3 25	3 25
San Francisco, warehouse, delivered	3 40	3 40

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2 15
Chicago, warehouse, delivered	2 15@3 00
Cleveland, warehouse, delivered	2 25@2 44
Dallas, warehouse, delivered	3 25
New York, warehouse, delivered, over 5 tons	2 90
Pittsburgh, large mill lots, stock lengths, f.o.b.	2 05
St. Louis, warehouse, delivered	3 15
San Francisco, warehouse, delivered	2 25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered by dealers to job, in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$20.50	$27.00	$25.50	$21.50	$28.50	$21.50
2.5	21.50	28.00	26.50	22.50	30.00	22.50
3.0	23.00	30.00	28.00	24.00	32.00	25.00
3.4	24.00	31.50	29.00	25.00	33.50	27.00

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and delivered by dealers, in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	New York (Warehouse Delivery)	St. Louis (Warehouse Delivery)	Dallas (Warehouse Delivery)	San Francisco (Warehouse Delivery)
032	22	$0.99	$1.01	$1.39	$1.45	$1.13	$1.22
049	28	1.26	1.29	1.76	1.80	1.38	1.55
068	35	1.54	1.58	2.18	2.25	1.67	1.91
093	40	1.98	2.03	2.79	2.90	2.00	2.46
126	57	2.45	2.51	3.45	3.55	2.55	3.03
153	68	2.92	2.99	4.13	4.25	3.15	....
180	78	3.35	3.43	4.73	4.85	3.47	....

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb., base:

	Blue Annealed No. 10 *	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3 35	$4 05	$4 90
Cleveland, warehouse, delivered	3 30	3 90	4 25
New York, warehouse, delivered	3 90†	4 00	4 75
Pittsburgh, large mill lots, f.o.b.	2 10@2 20	2 70@2 85	3 50@3 60
St. Louis, warehouse, delivered	3 45	4 25	5 10
San Francisco, warehouse, delivered	4 00	5 00	5 40

*Light plates, 64 lb. up to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	2½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	50%
Special and extra strong cast steel, round strand rope	27½%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4 00
Dallas, warehouse, delivered	4 50
New York, warehouse, delivered	4 50*
Pittsburgh, large mill lots, f.o.b.	3 10
St. Louis, warehouse, delivered	4 15
San Francisco, warehouse, delivered	4 60
Seattle, warehouse, delivered	4 25

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$11 20

SHIP SPIKES—Per 100 lb., block, from dealers' warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5 55	$5 10	$4 95
Seattle	7 75	5 95	5 50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Per 100 lb. keg, base, delivered from warehouse stocks, also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.40@$2.50	$3.30	$3.30	$2.95	$3.85	$3.20	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$12.00@$12.50	$14.50@$15.00	$11.00
Stove plate	8.00@8.50	12.00@12.50	9.00
No. 1 machinery cast	12.50@13.00	15.00@15.50	12.00*
Machine shop turnings	7.50@8.00	8.00@8.50	8.25
Cast borings	7.00@7.75	9.00@10.00	9.00
Railroad malleable	13.50@14.00	16.75@17.25	13.00
Re-rolling rails	13.75@14.25	15.75@16.25	13.00
Re-laying rails, 56@60 lb.	23.00@24.00	21.00@22.00	
Heavy melting steel, No. 1	12.00@12.25	14.00@14.50	11.00
Iron and steel pipe	10.25	10.00@10.50	8.75@10.50

*Net ton.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	31	Kansas City	71†
Birmingham	58	New Orleans	67
Boston	365	New York	34
Buffalo	265	Pacific Coast (all rail)	1.15*
Chicago	34	Philadelphia	32
Cincinnati	27	St. Louis	405
Cleveland	19	St. Paul	60
Denver	1.15*		

*Minimum weight on structurals, 60,000 lb. †Except iron or steel pipe and fittings.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43 00	$43 00	$43 00
Light rails, 25 to 45 lb.	36 00	34@36	34@36
Re-rolled rails	34 00	34@36	34@36

RAILWAY TIES—For fair-sized orders, f.o.b., the following prices bold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
St. Louis	Southern pine, creosoted	1.60	2.10
	White oak, untreated	1.18	1.44
	Red oak, creosoted	1.55	1.96
San Francisco	Sap pine or cypress, untreated	.91	1.20
	Douglas fir, green, untreated	87½	1.21
	Douglas fir, empty cell, creosoted	1.60	2.10
Montreal	Birch or maple, untreated	75@1.25	75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb., f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.50	$3.75@$3.85	$4.35
Track bolts	3.80	4.55	4.50	4.75@4.85	5.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.50	.....	.....

Tie plates: Price at Pittsburgh and Chicago mills, $2.15 per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	55.5%	42.5%	51.6%	39.0%
Cleveland, warehouse, delivered	55.5%	43.5%	53.5%	40.5%
New York, warehouse, delivered	53.74%	41.2%	50.32%	37.78%
Pittsburgh, large mill lots, f.o.b.	62%	50.5%	59%	47.5%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$40.00@$41.00	$37.00@$38.00
Burlington (N. J.) mill	38.00	35.00
Chicago	48.20@49.20	45.20@46.20
New York	40.60	37.60
Pittsburgh	48.50@49.50	45.50@46.50
St. Louis	45.60@46.60	42.60@43.60
San Francisco	50.00@51.00	47.00@48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.13½	$0.22½	$0.75	.....	.....	.....	.....
Baltimore	..	.30	.58	..	$1.93	..	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.185	.30	**.555**	**1.35**	**2.25**	**3.70**	**6.50**
Chicago	.15	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.135	.21	.405	1.25	2.025	3.67	5.74
Cleveland	.18	.294	.567	1.35	2.43	4.824	7.38
Dallas	.256	.42	.79	1.70	3.00	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	..	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.84	3.49	4.97
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.195	.325	.585	1.10	2.11	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.147	.26	.468	1.092	1.872	3.65	4.80
San Francisco	*.1925*	*.275*	*.495*	*1.155*	*1.98*	*3.30*	*4.95*
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Prices delivered by dealers, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	60.00
6	112.00	112.00	85.00	110.00	112.50	112.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:

New York....*$0.161* Chicago....*$0.165* Minneapolis....*$0.17*

WHITE AND RED LEAD—Base price per 100-lb. keg, f.o.b., New York: White, dry $13.75; White, in oil, $14.25; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb.	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb.	*5.50@ 6.00*
Soda ash, 58%, in bags, per 100 lb.	1.32@ 1.35
Chlorine, cylinders, per lb.	.05@ .08
Bleaching powder, in drums, f.o.b. works, per 100 lb.	2.00@ 2.10
Calcium chloride, in drums, f.o.b. works, per ton	20.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ½-in., 7-ft., 6-in.; ⅝-in., 6-ft., 1-in.; ¾-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft, 8-in. Following prices are quoted by dealers per pound for ½-in. and larger:

Atlanta	$0.25	Kansas City	$0.25
Baltimore	.225	Los Angeles	.205
Birmingham	.26	Minneapolis	.24
Boston	.225	Montreal	**.26**
Chicago	.22	New Orleans	.25
Cincinnati	.21	New York	.215
Cleveland	.21	Philadelphia	*.23*
Dallas	.21	San Francisco	.205
Denver	.24	Seattle	.205
Detroit	.23½	St. Louis	.235

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $2.08

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.91½

ROOFING MATERIALS—Prices f.o.b., New York, delivered by dealers to contractors in carloads:

Asphalt felt, per 100 lb.	$2.60
Tar felt, per 100 lb.	2.60
Asphalt coating, per gal.	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Prices delivered by dealers to contractors, in carloads, f.o.b. New York, per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouse:

AA .....83% A .....86% B 88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.2275	.2525
Birmingham	.22	.245	Montreal	**.20**	.24
Boston	.22	.25	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.1875	.23	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	*.15*	*.15*
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, rough, delivered to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Merchantable Long-leaf Yellow Pine	No. 1 Common Douglas Fir
3x4 to 8x8	$55.00	$42.50
3x10 to 10x10	65.00	42.50
3x12 to 12x12	75.00	42.50
3x14 to 14x14	87.50	50.00

Chicago—Prices, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$43.00	$42.00
3x10 to 10x10	50.50	42.00
3x12 to 12x12	62.50	42.00
3x14 to 14x14	74.50	43.00

San Francisco—Douglas fir, No. 1 common, rough, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	**$33.00**	**$36.00**
3x6 and 8	**33.00**	**36.00**
3x10 and 12	**33.00**	**36.00**
3x14	**37.00**	**39.00**

Other Cities—Delivered by dealers, No. 1 Common, rough, per M. ft:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$55.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.00	$53.50	$61.00	75.00	$50.25
Birmingham	45.00	.....	.....	.....	60.00	.....
Boston	48.50	47.00	47.50	48.50	58.00	52.00
Cincinnati	52.50	62.50	.....	.....	70.00	57.50
Cleveland	65.00	65.00	.....	.....	65.00	65.00
Dallas	65.00	57.50	57.50	55.00	65.00	57.50
Denver	.....	57.00	57.00	55.00	.....	55@58
Detroit	58.75	**52.00**	.....	.....	**70.00**	**52.00**
Kansas City, Mo.	**60.00**	**60.00**	.....	.....	56.00	56.00
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	58.00	53.25	38.25‡	.....	58@60	53.25@54.75
Montreal	.....	.....	.....	.....	**56.00**	48.00
New Orleans	50.00	46.00	.....	44.00	67.00	63.00
Philadelphia	*50.00*	*48.00*	*42.00*	*48.00*	*60.00*	*48.00*
Pittsburgh	65.00	70.00	75.00	65.00	65.00	65@72
St. Louis	49.00	45.00	.....	.....	61.00	44.00
Seattle	.....	*22.00*	.....	.....	.....	*21.00*

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$42.50	.....
Baltimore	56.00	$45.00	$45.00	.....	.....
Birmingham	36.00	.....	.....	43.00	.....
Boston	45.00	43.00	42.50	48.50	$47.50
Cincinnati	65.00	57.50	.....	42.00	55.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	.....	.....
Denver	.....	44.00	46.00	.....	50.00
Detroit	45.00	43.00	.....	**48.50**	**47.00**
Kansas City, Mo.	**55.00**	**55.00**	.....	**49.00**	**49.00**
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	53.00	47.00	39.75‡	51.00	46.00
Montreal	56.00	.....	.....	.....	.....
New Orleans	43.00	40.00	.....	50.00	46.00
Philadelphia	*52.00*	*43.00*	*41.00*	*55.00*	*44.00*
Pittsburgh	50.00	60.00	59.00	42.00	.....
St. Louis	45.00	42.00	41.00	41.00	39.00
Seattle	.....	*20.00*	.....	.....	*21.00*

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.33	.41
14 in.—2 ft. from butt	5i in.	85 to 89 ft.	.38	.41